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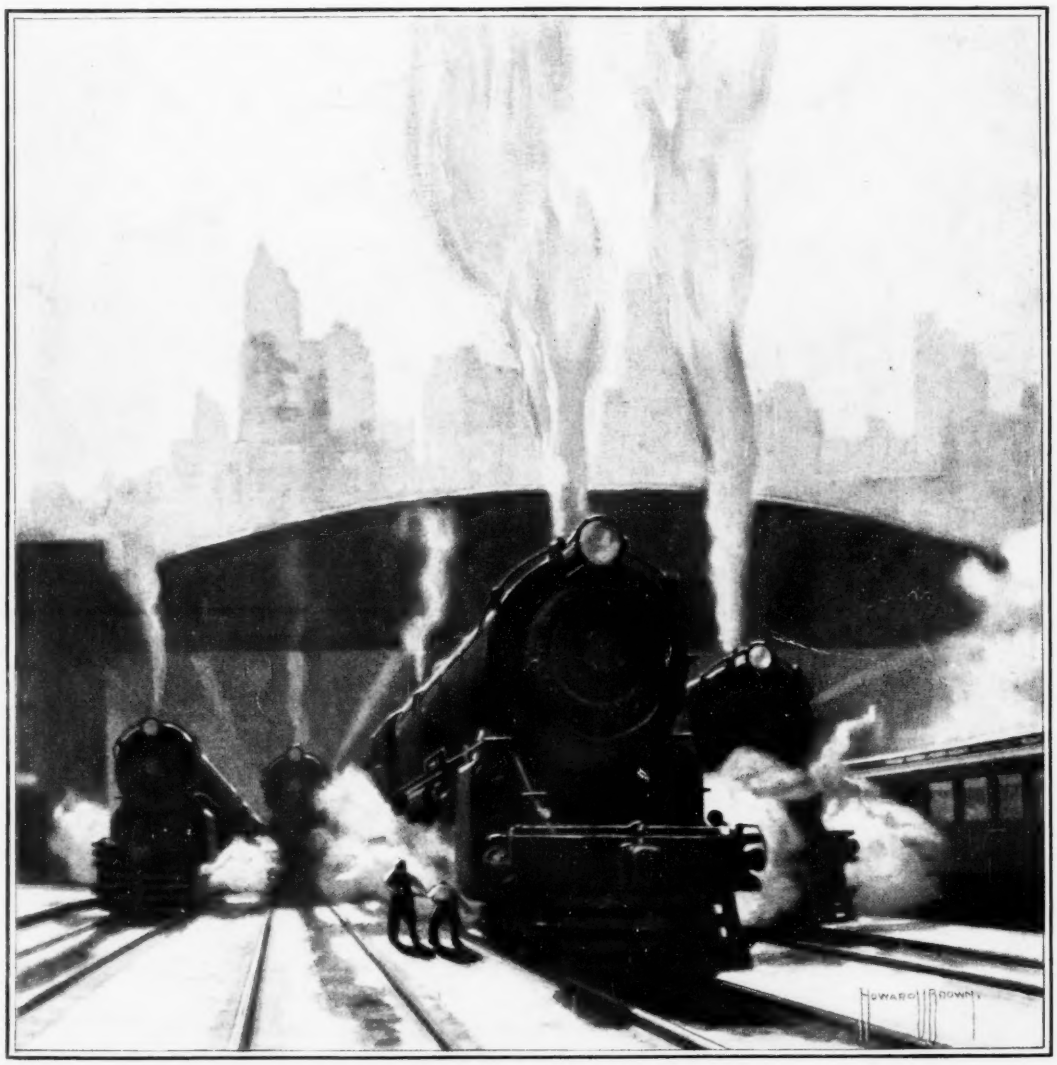
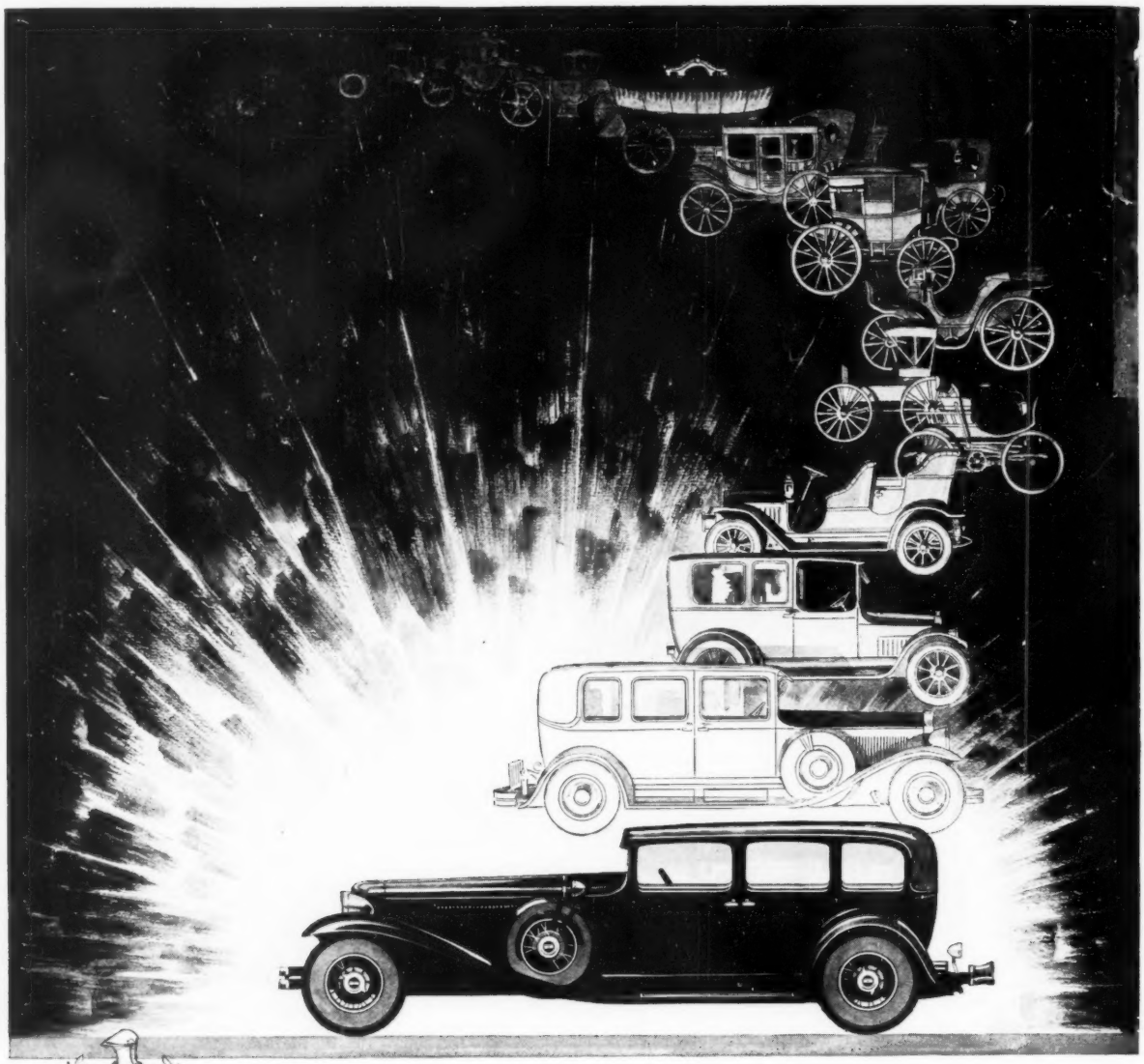


Awaiting the Dispatcher's Orders



Owners tell us the Cord front-drive has brought back the thrill, long forgotten: that of driving their cars for the pleasure of driving—E. L. CORD

CORD FRONT DRIVE

SEDAN $3095 . . BROUGHAM $3095 . . CABRIOLET $3295 . . PHAETON $3295 Prices F. O. B. Auburn, Indiana. *Equipment other than standard, extra*

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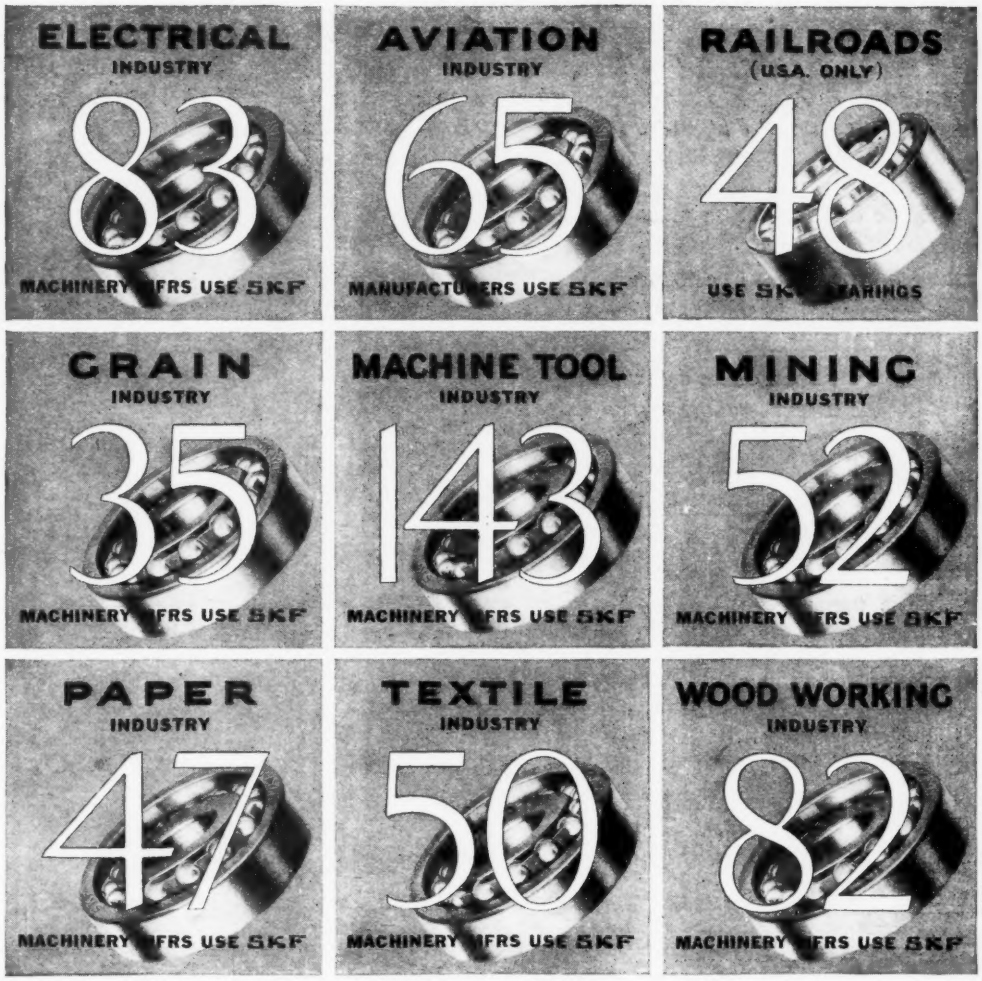

The figures above show a few of the many industries and the machinery manufacturers that use SKF anti-friction bearings.

IN EVERY INDUSTRY —*PREFERRED*

LOOK at the illustration of this advertisement again . . . nine representative industries . . . and in each SKF stands supreme. Forty-eight American railroads use SKF Bearings. Sixty-five airplane or aircraft equipment manufacturers use them. And in all the others, the manufacturers who build the machinery upon which these industries depend select SKF.

Why? Certainly not merely because SKF is the "Highest Priced Bearing in the World." Certainly not merely because it IS high-priced.

. . . But because the bearing-wise engineer insists upon getting the performance—the dependability—the real *economy* of "The Highest Priced Bearing in the World."

Nothing Is Apt to Cost So Much As the Bearing That Cost So Little

SKF INDUSTRIES, INCORPORATED

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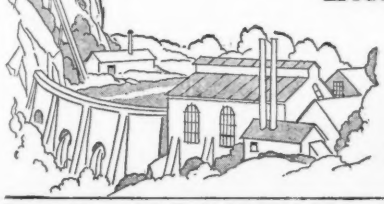

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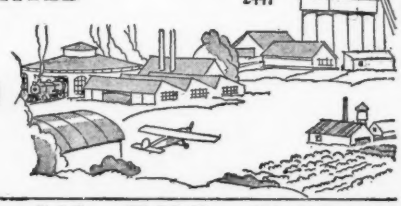


THE HIGHEST PRICED BEARING IN THE WORLD

Has your favorite service station man seen this demonstration?

AT the right is the demonstration machine which engineers from the Ethyl Gasoline Corporation take from place to place to prove how Ethyl "knocks out that 'knock'" and develops an engine's maximum power.

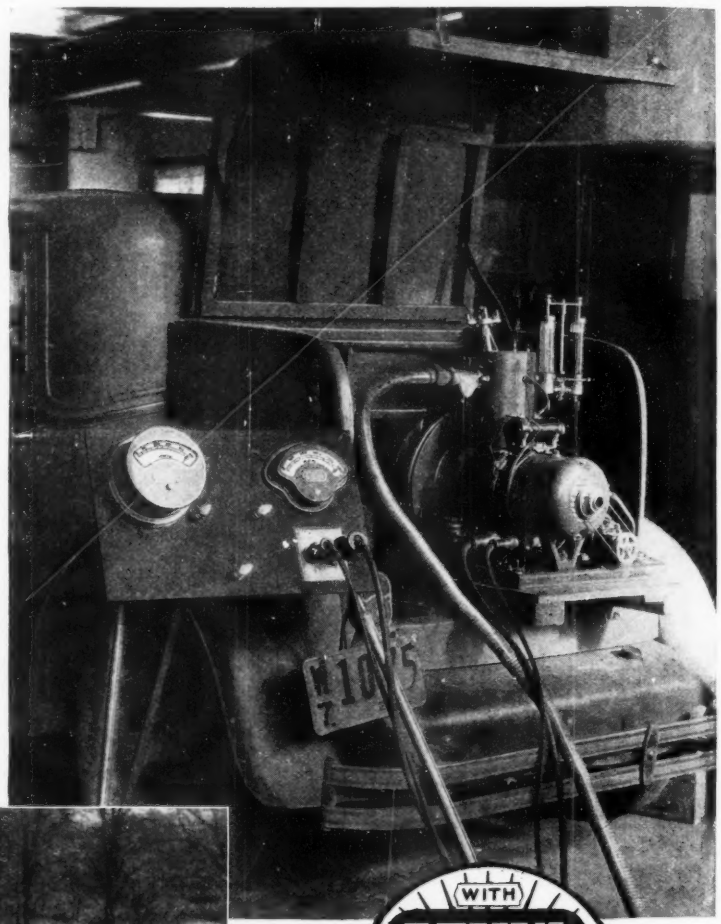
In those two vials at the right of the cylinder is the fuel. One contains ordinary gasoline, the other Ethyl Gasoline.

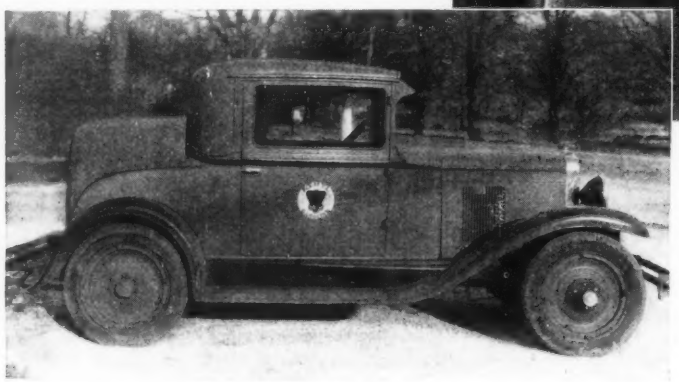
By turning the valve between them, ordinary gasoline flows into the combustion chamber. The engine "knocks"; its speed decreases; the power begins to drop.

Then the valve is turned in the opposite direction to feed Ethyl into the chamber. The engine quiets swiftly. "Knock" goes out. R. P. M's (engine revolutions per minute) increase. And the engine delivers the power of which it is capable.

That's why thousands of service station men advise you to use Ethyl in your own car. They know that *any* car performs better with Ethyl Gasoline in its tank.

Ethyl Gasoline Corporation, New York City





Fitted into the rear of this car is the "knock" demonstration machine. (Above at right) The machine ready for action.

WITH ETHYL BRAND OF ANTI-KNOCK COMPOUND ETHYL GASOLINE CORPORATION NEW YORK, U.S.A. Knocks out that "knock"

Wherever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating.

ETHYL GASOLINE

© E. G. C. 1930

The active ingredient now used in Ethyl fluid is tetraethyl lead.

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SCIENTIFIC AMERICAN

April 1930 — *ORSON D. MUNN, Editor* — *Eighty-sixth Year*

Owned and published by Scientific American Publishing Company, Orson D. Munn, President, Louis S. Treadwell, Vice-President, John P. Davis, Treasurer, I. Sheldon Tilney, Secretary, all at 24 West 40th Street, New York, N. Y.

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COVER

One can almost hear the throb of the locomotives shown on our cover this month, so realistically has our artist, Howard V. Brown, painted them. The groan of the air compressor and the hiss of escaping steam seems to imbue them with life, and they appear as huge panting monsters anxious to be on their way. "Awaiting the Dispatcher's Orders" therefore serves as a fitting introduction to the article "'Round a Round House" on page 291.

CUMULATIVE ADVERTISING PAYS!

As Proved by the Advertising Record Of a Few Present-Day Users of the SCIENTIFIC AMERICAN

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S K F INDUSTRIES, INC.	1930, 1929, 1928, 1927, 1926, 1925, 1924, 1923, 1922, 1921, 1920, 1919 — **12 years**
REYNOLDS, R. J. TOBACCO CO.	1930, 1929, 1928, 1927, 1926, 1920, 1919, 1918, 1917, 1916, 1915 — **11 years**
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ADVERTISING HAS DONE ITS JOB FOR THESE ADVERTISERS, AND THE SCIENTIFIC AMERICAN IS JUSTLY PROUD OF THEIR CONTINUED CONFIDENCE

The Reason, Contained in Our Latest Book of Facts, is Yours for the Asking

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24 West 40th Street, N. Y. C.

Mid-Western Office
6 N. Michigan Ave., Chicago

Pacific Coast and South
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Los Angeles, San Francisco, Seattle, and Atlanta

Looking Ahead *With the* Editor

May—Aviation Number

THERE has been some pessimistic talk relative to the continuation for a long period of the recent slump in aviation. We take little stock in such talk; we have faith in the industry. It may be marking time now but soon, we believe, it will resume its march with a greater stride than ever. The younger generation will attend air schools in greater numbers, more individuals will purchase planes for private use, and certain present-day concepts of air practice will have to be revised. In our May issue, therefore, we will publish an article on air schools which will tell both parents and youngsters how to select schools for the youngsters' training; a discussion of what details of construction, what features of operation, and what factors of safety to look for in the plane you buy; and a third article which shows that stunting is desirable—sometimes. Still another will describe a large air transport system; and shorter items will cover various interesting and technical advances that have been made by the industry.

Tweedle-dum and Tweedle-dee

THE difference between these two, from "Alice in Wonderland," is popularly considered so trivial as to be unworthy of notice, but the difference between Tweedle-dum and Tweedle-dee, in scientific research, "has been responsible," you will be told in a coming article, "for the very large number of advances that have taken place in science during the past four or five centuries." Look for this absorbing story of science.

Professor Michelson

WE have on hand ready for release a splendid appreciation of Professor Michelson and his work. It shows the human side of this man who is often thought of as a thinking machine; and carries us through his life from his entry into this country to the present day. His graduation from the Naval Academy, the Michelson-Morley experiments, his invention of the interferometer named for him, and his determination of the velocity of light are interestingly discussed.

Dirty Air

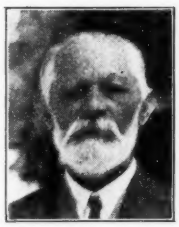
LOOKING toward the further suppression of smoke and dust producers, the Mellon Institute of Pittsburgh has been conducting researches on air pollution which should have far-reaching effects. The article on this vital subject, which we shall publish soon, makes not only an interesting story but should prove suggestive of a method of tackling local air pollution problems in many cities in this country and elsewhere.

Every Issue Fully Illustrated

¶ *Men are known by the magazines they read. What easier road to distinction could there be than reading the* SCIENTIFIC AMERICAN—*at four dollars a year?*

Among Our Contributors

Theo. Krysto



DURING his long life Dr. Krysto has been a physician, a farmer, a writer for Russian magazines, an adviser to the Governor General of Western Siberia, a Russian government Agricultural Commissioner to the United States, a Senior Specialist in the Russian Department of Agriculture, a director in a large company, and again a physician in the little California town of Alhambra. Now, at the age of 72, he is starting an enterprise which may be of inestimable value to mankind. His aim is to show the world that two of its scourges—malaria and blood-sucking mosquitoes—can be eradicated easily, cheaply, and quickly by natural methods.

Robert E. Goode

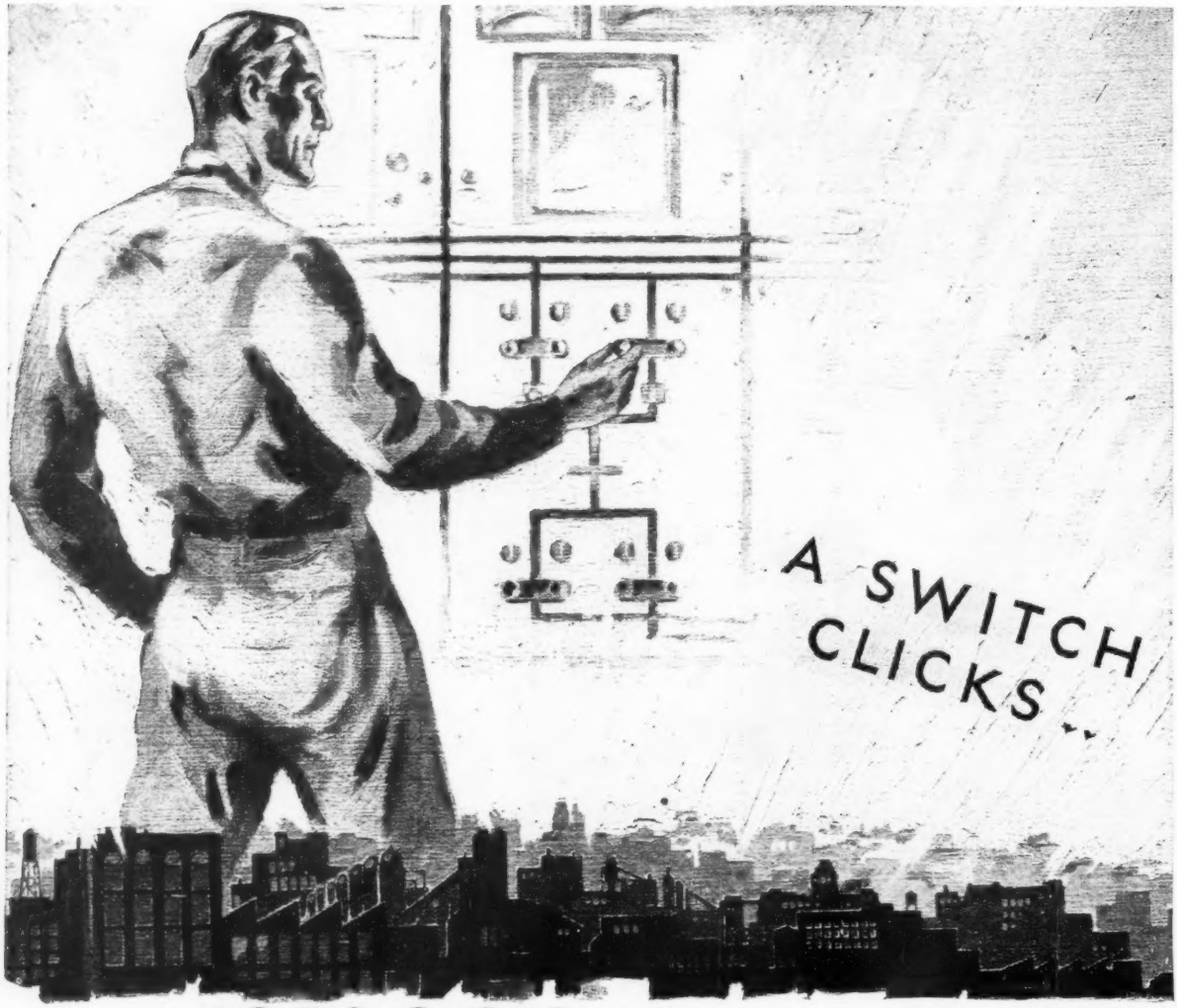
MR. GOODE belongs to that small army of civilian technicians which is doing good work for the navy. He is a photographer and an artist attached to the Naval Air Station at San Diego, California. He has taken excellent snapshots from the air with all kinds of cameras, including the familiar cheap box type. His article in this issue thus is based upon extensive experience—no better authority could be desired.

Roy L. Moodie

HAVING taken degrees in paleontology and in anatomy, Professor Moodie is able to gain a perspective of past and present; his studies have linked the pathological past of *homo sapiens* with the present. His researches have been in paleopathology, the history of anatomy, the development of the skeleton, and cognate subjects. Professor Moodie has taught biology, zoology, and anatomy, and has taken part in paleontological expeditions to our great southwest.

James A. Tobey

DR. TOBEY is a graduate of the Massachusetts Institute of Technology, where he received the first doctorate in public health (Dr. P. H.) given to a non-medical graduate. He was formerly Associate Editor of the *American Journal of Public Health* and has written extensively on the subjects of hygiene and sanitary science. Dr. Tobey is now Director of Health Service for a large company which operates in New York City.



and 1,253,000 Horsepower is Released to Industry

Climatic, labor, transportation, market and other factors give to Southern California very definite industrial advantages over other sections of the Pacific Coast and of all America.

But the one important factor that vitalizes all these advantages in behalf of industry is . . . .

Abundant Low-Cost Power

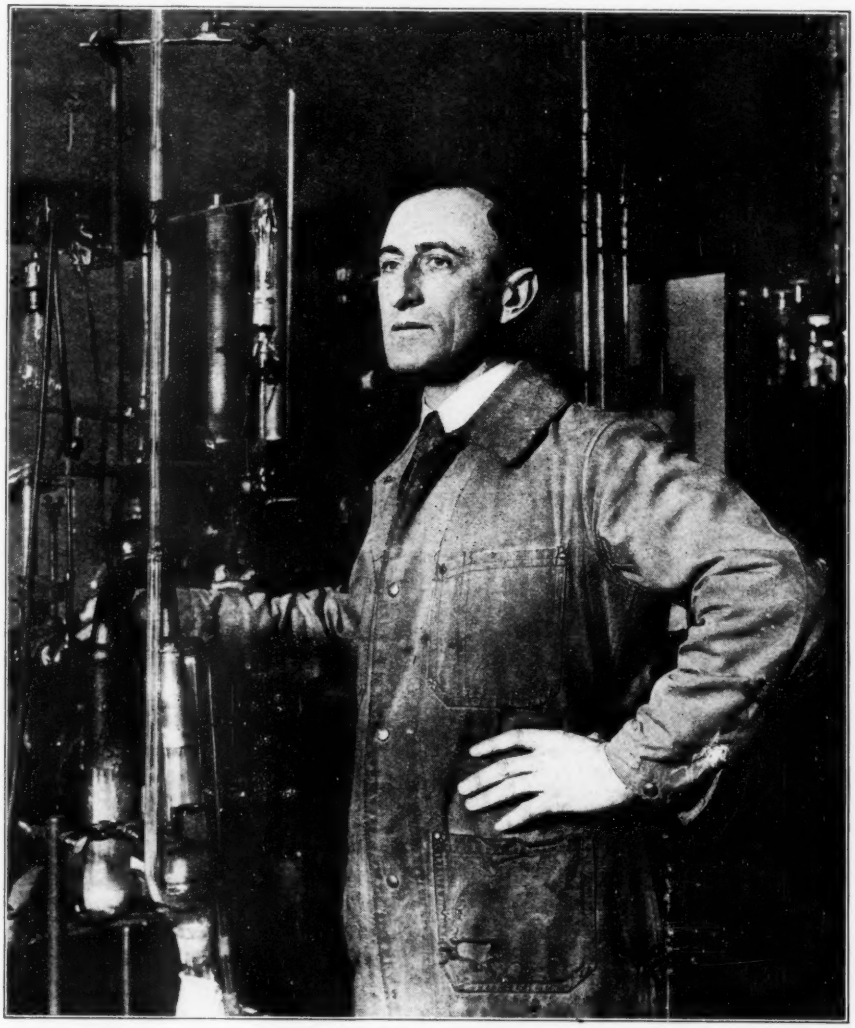
With a total investment of more than $320,000,000.00 in its generating and distributing system, the Southern California Edison Company serves an area of more than 55,000 square miles. Anywhere within this area, power for industry is immediately available at very low rates.

More than a billion horsepower-hours of electric energy were supplied by this company to industrial consumers in 1929.

Southern California Edison has been an important factor in the marvelous industrial growth of Los Angeles County. The opportunity for industry here was never so obvious nor so great as it is now.

Information regarding the opportunity in Los Angeles County for any specific industry will be sent upon request to Industrial Department, Los Angeles Chamber of Commerce.

SOUTHERN CALIFORNIA EDISON COMPANY . . . LOS ANGELES



Arthur Jeffrey Dempster

THE Thousand Dollar Prize of the American Association for the Advancement of Science has been awarded this year to Professor A. J. Dempster of the famous Ryerson Physical Laboratory at the University of Chicago, for his "noteworthy contribution to science" in proving that the proton has wave characteristics. In the words of Professor Arthur H. Compton, Nobel Physics Prize Winner, also of Ryerson Laboratory, "the most important contribution of 20th Century physics is that the physical world can be reduced to three kinds of particles—protons, electrons, and photons, [see Professor Compton's article, SCIENTIFIC AMERICAN, February, 1929.—Editor], and that each of these particles has also the characteristics of waves. The last stage is the proof that the protons, the positively charged parts of matter, have wave characteristics. It is this completion of the great work of 20th Century physics which has been accomplished by Professor Dempster." In that Dr. Dempster's discovery demonstrates the dual nature—particle and wave—of the proton, it is one vindication of the prediction of the French physicist de Broglie, mentioned on this page last month. Following de Broglie's prediction Davisson and Germer of the Bell Telephone Laboratories proved the wave nature of the electron; Dempster's research does the same thing for the proton.

America's Foremost Physical Laboratory

THERE is no formula for determining which is the "foremost" physical laboratory, but the Ryerson Laboratory at the University of Chicago has given the world so many famous physicists that the majority of those who are qualified to judge would perhaps so nominate it.

How is such a choice as this arrived at? What makes a scientific institution a leader? That which is most likely to assure advance is the strong inspiration and leadership of an outstanding personality, and it is therefore not a far cry to attribute Ryerson's supremacy mainly to the leadership of the great physicist Michelson who has been its head from 1892 until recently.

Michelson, Millikan, Compton—what a trio this center of physical research can boast! Professor H. G. Gale whose name is linked with Michelson's in connection with ether drift experiments; Samuel G. Stratton, President of the Massachusetts Institute of Technology; Professor A. J. Dempster, whose picture is on the previous page; Dr. W. F. G. Swann, Director of the Bartol Research Foundation; Dr. Frank B. Jewett, President of the Bell Telephone Laboratories; and Dr. C. J. Davisson of the same great laboratories, who proved the wave-atom theory —these and some 130 other physicists are all "descendents" of the Ryerson tradition.

In an address before New York business men, the physicist R. A. Millikan, now of California Institute of Technology, spoke on "Michelson's Economic Value." He proved that Michelson was a bigger world asset than any billion-dollar corporation, or all of them in existence. Thus much can one simple man accomplish for the world by the right kind of leadership in science.

ON AN OLD GOAT FARM

According to an old drawing, a copy of which we saw a few days ago, the site occupied by this already famous structure, the Chrysler Building, was a goat farm only 55 years ago. The section beyond it, one may well imagine, must have been open farm land with a residence here and there. In the distance is the East River and one of the bridges spanning it. In this view, taken a short time ago, the tower is not quite complete

Manhattan's Mightiest "Minaret"

Many Unique Features and Engineering Problems Involved in Building the World's Tallest Structure

By F. D. McHUGH

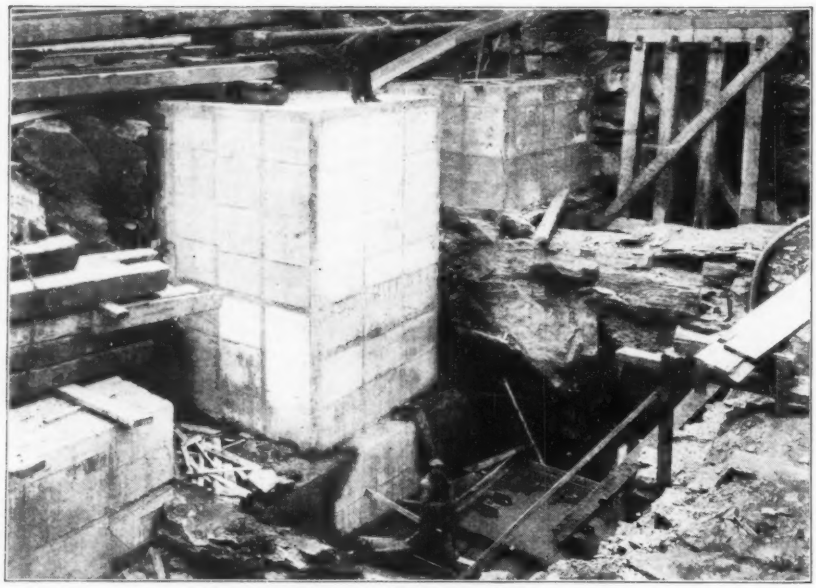
STANDING out like some shiny new minaret among many squat mosques of business, a needle-pointed tower building has been added to the mid-town skyline of New York City. And if one is fortunate enough to view it from the exact angle at which the sun is reflected directly, then he will be treated to a sight that will impress him with its unique quality: he will see what appears to be a towering sword of fire topping the structure. Perhaps he will be puzzled, and upon inquiring will learn that the finial spire of this newest of New York's new edifices, the Chrysler Building, is entirely covered with stainless steel and, furthermore, that this metal is used generously on cornices, arches, and other parts of the upper tower structure.

The Chrysler Building is the tallest building, and, in fact, the tallest man-made structure in the world. It tops the Woolworth Building, holder of the first record for many years, by more than 200 feet and beats the 1000-foot Eiffel Tower of Paris, holder of the second record since 1889, by 44 feet. It rises 1044 feet above the street curb line.

FROM a base approximately 200 feet square occupying the plot on the east side of Lexington Avenue between 42nd and 43rd Streets, this structure rises through several set-backs to the 31st story at which point the tower starts. The tower at this level, and continuing to the 59th story where there is another set-back, measures about 88 feet by 107 feet. The 59th story set-back changes the plan of the tower so that it measures 88 feet by 88 feet. Then from the 61st floor setbacks, the contour starts changing into the multi-arched dome which finally converges into the needle-like finial. Below ground there is a basement, a cellar, and a sub-cellar; and above ground, running into the dome, there are 71 stories, plus the final 34 feet of the dome itself, plus the 185-foot finial. The total floor area is approximately 1,200,000 square feet. In the basement will be a restaurant, stores, and bank vault; and it will be accessible, through corridors, to both the Grand Central Station and the subway.

Besides the stainless steel, which is so strikingly effective in appearance, there are many other unique features about this building and it is the holder of other records in addition to the height record. Also several unusual problems were encountered in the work of construction.

It has been the accepted, although



TO SUPPORT A TREMENDOUS LOAD

One of the huge column foundation pillars of concrete. This supports a column which runs directly through to the top of the building, its total load being approximately 3700 tons

tragic, belief that, in erecting the steel for a modern building, one workman will be killed by accident for every floor of the structure above the fifteenth. On the Chrysler Building 2500 to 3000 men were employed at all times and a number of accidents occurred, but not one resulted in death outright and only one of those injured died later. This splendid record of safety was due to the many precautions taken by the builders and to the general systematization of the work.

GENERAL construction methods usually allow piles of structural materials of various kinds to be stored in any available place awaiting the opportunity to be carried to the point needed, after the foreman concerned with their disposal is located. This is conducive to confusion, and confusion, where hundreds of men are continually active, increases the danger. In going about their individual tasks, men stumble over this stored material or step on loose ends and fall perhaps many floors.

This condition did not obtain in the Chrysler Building. When a truckload of material—sand, cement, steel, et cetera—arrived at the street office, the man responsible for its disposal was immediately called on the telephone. No matter in what part of the building he may have been at that moment he would receive the call, for the temporary telephone line extended throughout, and all this man had to do was to listen for his particular number of rings, or code call, for bells rang on all floors. Upon getting the message, he gave instructions for placing the material at once where it would be used.

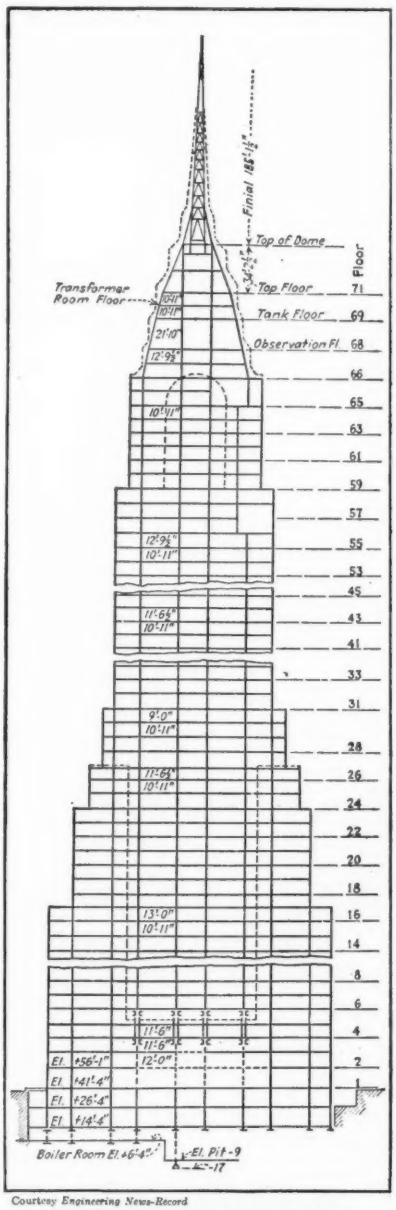
Other safety measures adopted were the use of guard rails with locked doors around the construction elevator shafts where they pass through each floor, and the use of a minimum amount of scaffolding on the outside of the building at all times. In fact, the materials-hoisting elevator shafts and their necessary scaffolding, composed primarily of steel tubing, were all grouped in the rear of the building.

Another record held by the Chrysler Building is that of possessing three of the longest continuous elevator shafts in the world. Indeed it is said by some that in this building the ultimate limit of practicable elevator operation and therefore the most economical building height has been reached. This belief is based upon the claim that it would be impracticable to attempt to support an elevator car and its cables for a direct run of more than approximately 1000 feet, and furthermore that shafts in a number of relays would take up too much revenue-producing space.

ON the other hand, the American Institute of Steel Construction reports as a result of an extensive study of the height question that while 1000 feet seems to be the maximum economic height, the maximum physical and engineering limit is 2000 feet. It is interesting to note their reasons for this figure; namely, the enormous weight of the elevator cables that would be required, and the capacity of the human ear drum to withstand the vibration in an elevator car traveling at a speed that would have to exceed 1500 feet per minute.

One of the most important factors in the design of a building of this character is the problem of wind stresses and the general stiffness in the joints of the multi-story rigid frame. Wind bracing is necessary primarily to prevent occupants from getting seasick or frightened. In the Chrysler Building special care was taken in selecting column sections in the center of the building to get continuous framing throughout and enable rigid bracing to be attached. This required a great deal of special study inasmuch as grouped in this part of the building are the elevators and stair openings which were arranged as compactly as possible in order not to use any more rentable space than absolutely necessary.

Structural steel was so designed and erected as to distribute wind stresses throughout the structure. There are



Courtesy Engineering News-Record

SCHEME OF THE BUILDING

Sectional diagram of the building showing the general layout, set-backs, pipe galleries, tower, observation floor, et cetera

no "soft" spots but a harmonized balance of members so that neither a steady wind nor a sudden gust will distort the building or cause jarring vibration. It is expected that the building will vibrate, but this vibration will be rhythmic. The writer visited the building a short time ago on a fairly windy day and was not aware of any vibration in the tower stories. This was due perhaps to an unconscious physical accommodation to sway. For the purpose of further study of this question, wind stress indicators may later be installed at all telltale points in the building.

The erection of approximately 21,000 tons of structural steel offered several unusual problems, although the general framing does not differ radically from that of other skyscraper buildings.

The great elevator hall extending through the building made it necessary to carry four columns on two-story trusses. These trusses extend through the fourth and fifth stories, the columns extend to the 58th floor, and each carries the tremendous weight of 3,800,000 pounds. The section of one of the columns supporting the truss has an area of 532½ square inches, and its total weight per lineal foot is 1770 pounds!

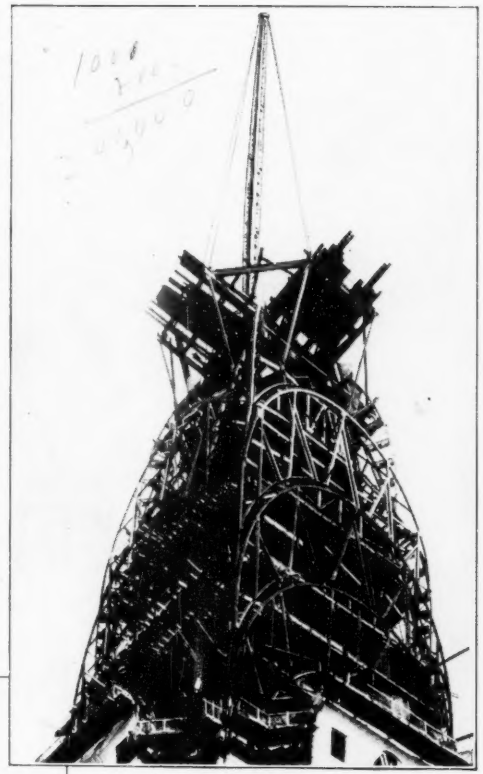
THE four center columns are in an unbroken line to a point 30 feet above the 74th floor, from which level the spire starts. In the dome-like part of the tower the 12 wall columns are sloped, following as closely as possible the exterior walls. Structural steel angles, bent to follow the architectural outline of the dome part of the building were of such unusual construction that they were fabricated by a ship-building company.

It is interesting to note that the total load of the building, including all live and dead loads, is equal to the combined tonnage of three large battleships—that is, 112,000 tons!

In the erection of the finial, the Chrysler Building scored a triumph which for daring conception and unique execution has not been equalled for many years, if at all, for the interest it aroused among engineers and laymen alike. The architect, William Van Allen, originally designed the structure to be 808 feet high, surmounted by a dome composed of a series of gradually decreasing arches, and, finally, by a cupola-like dome.

Construction work started in October, 1928, and by the fall of 1929 the steel structure was rapidly nearing completion. In the meantime, the design of the upper part had been changed, the finial being designed to take the place of the cupola-like dome, but this fact had been kept secret. Then suddenly on a day in November, 1929, passersby were amazed to see the finial, a lattice-like structure, emerge full grown from the top of the steel and push skyward a distance of 185 feet.

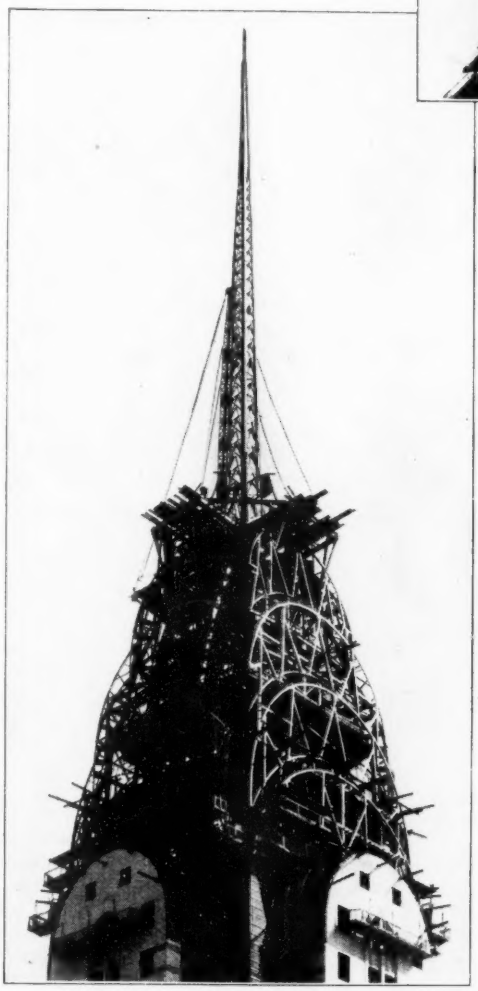
Since it was expedient to erect this finial as a unit and its weight of 27 tons precluded the possibility of lifting it all the way from the street, and since, furthermore, it would have been difficult to up-end into position, it was assembled vertically within the building frame. Fortunately, a fire tower existed in the top section of the main structure and so the finial was built therein of formed and numbered sections. Since its base measured only 8 feet on a side, this operation was simply done by providing a support at the 65th floor level and temporarily omitting some minor sections of the building frame.



FOR RAISING THE FINIAL

The platform and the 20-ton derrick that was used, its boom being held practically vertical

An outrigger platform was erected all around the top of the dome and a guy derrick was mounted on this. A line from the derrick was then attached to the completed finial and it was pulled out vertically, inched slowly upward until finally its base was in position for bolting and riveting into place permanently. In passing, it may be said that this unique operation may never be necessary or desirable in any future building.



THE LATTICE-WORK FINIAL

This unique spire was assembled within the building and erected in place by lifting it out vertically. Note intricate framing for the tower

SEVERAL floors of the completed structure will be devoted to operating equipment. The cellar and subcellar will be used for the installation of mechanical equipment, mechanics' shops, main switchboard room, transformer vault, telephone room, and store rooms. The 30th and 60th floors will be pipe galleries, the entire space of both being taken up by steam mains and distributing lines, electrical apparatus, and general operating equipment. The 68th floor will be used for observation purposes, the 69th for water tanks, and the 70th as a transformer room.

One of the striking features of the building is the manner in which

electricity at a voltage of 13,200 was brought directly into the building. High-tension cables carry this current to four transformer vaults located at different levels. These four transformer banks are treated as regular transformer sub-stations and the fact that they are located vertically one above the other, instead of horizontally, as along a highway, in no way changes their functioning.

AS THE WORK PROGRESSED

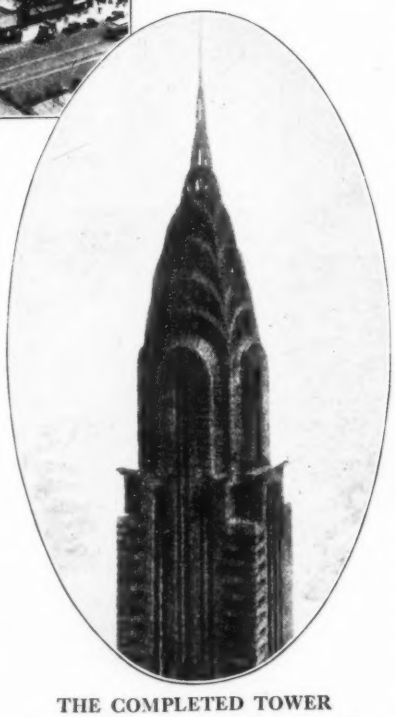
It will be noted that the structure was kept comparatively free of scaffolding

The secondaries of these transformers are brought out to switchboards where they become the points of origin of the various customers' feeders. The high-tension feeders which are brought in from the street to supply the primary energy for the transformers are kept isolated from the building in raceways embedded in concrete.

Another feature of the Chrysler Building's electrical design is the full recognition of the arrival of the electrical era expressed in the facilities provided on every floor for the application of electricity to every office need. This is done by the installation of underfloor raceways by means of the Orangeburg duct system, sections of which are spaced at sufficiently close intervals to allow an electrical connection to be made at any point within the extensive floor area of the building.

Seasonal and even hourly demands for heat may be taken care of due to the effective arrangement of the heating system. That is, during seasons in which the sun heats up offices with a southern exposure and leaves those on the northern side cold, during the morning when the offices on the western side are cold, and during the afternoon when offices on the eastern side are cold, steam may be turned into the pipes feeding the radiators of the cold tiers of offices. To make this possible, the entire heating system has been divided into four zones.

Steam for heating the building will be purchased from the New York Steam Corporation. For the benefit of those unfamiliar with this system, it should be explained that this corporation has several steam plants at locations convenient for the reception of coal shipments and sufficiently far removed from busy sections of the city to prevent their throwing over the city quantities of smoke and soot. Among the advantages of this system may be listed the facts that a cheaper grade of coal may be burned, fuel does not have to be trucked through heavy traffic, and the building purchasing steam in this manner does not have to install machinery and equipment.



THE COMPLETED TOWER

An artist's rendering of the tower with its finial, as it will look when complete

The steam mains of this corporation extend over a wide area of the city, constantly carry live steam, and may be utilized in the same manner in which electrical power lines carry current and are tapped. For the Chrysler Building, the steam mains are tapped at two points, one on the 42nd Street side and one on the Lexington Avenue side, so that steam may be supplied from one or two of the steam company's stations. The entering steam is metered and then taken through a pipe gallery to a main supply riser which carries it, at a pressure of 40 pounds per square inch, as far as the 60th floor.

In the pipe galleries at the 30th and 60th stories, the steam pressure is reduced to feed a set of secondary supply mains. From the mains on the 60th floor, steam pipes are carried up to the top floor and down to the 31st floor. From the mains on the 30th floor, steam is carried down to the 17th floor. Finally, steam is carried from the cellar pipe gallery upward to the 16th floor. Welding was adopted for joints and connections wherever practicable — in the sub-cellar level, throughout the main supply riser, and in the 30th and 60th floor mains.

TWENTY-EIGHT passenger elevators, two service elevators, two to the tower, one for the restaurant, and a sidewalk lift have been installed. The passenger elevators and the two tower elevators are Otis electric, gearless, machine type, with full automatic signal control and automatic leveling. This type is practically self-operating since the operator simply pushes buttons for all the floors desired on any one trip, and the mechanism stops the car at those floors as they are reached, levels off, and opens the doors. Likewise, a signal from any floor automatically stops the car as it reaches that floor. The passenger elevators have a capacity of 2500 pounds and a speed of 1000 feet per minute—or about 12 miles an hour, vertically!—but will be run at 700 feet per minute until the city code allows the higher speed.

Cold water for fire and sanitary purposes throughout the building is pumped to the upper floors in three stages by means of house pumps and fire pumps. By installing brass pipes in the hot water system throughout and on the cold water system for all pipes up to and including 2½ inches, the owners have exercised forethought to obviate the trouble of rusted and clogged pipes in the future.

Other problems were encountered and other unique practices or adaptations than those described here were involved in the building of this structure, but they were of such a specialized or general nature as to fall without the scope of this article. W. R. Squire & Son and H. G. Balcom designed the steel, and Post and McCord were the steel contractors. William Van Alen was the architect; Fred T. Ley & Company, the general contractors; and Louis T. M. Ralston, the consulting engineer.

OUR POINT OF VIEW

Safety Needed

THERE is quite a contrast between the remarkable record of safety achieved by the builders of the Chrysler Building, and the apalling death rate suffered during the past year by house wreckers. Only one death resulted from accidents sustained in construction work on the above mentioned building, but 20 deaths are reported as the result of house-wrecking operations in New York City in 1929, primarily because of the method of demolition.

Prior to last year, buildings and houses being destroyed to make way for larger, more modern structures, were demolished floor by floor. House-wrecking contractors then conceived the method of breaking through all floors of a building, regardless of height, and dumping all material directly to the basement for removal. This did speed up demolition, but at the same time it subjected the workmen to far greater danger than before because, with floors broken through, nothing is left of a building but a mere shell of walls on the top of which laborers must work. Practically all the men killed while working in this way, fell from these walls directly to the basement, in many cases 10 to 15 floors.

Today there is necessity for speed in all industry and construction work but this speeding up in all cases increases the hazard and the demand for more effective safety measures. Whether, in house wrecking, this points to a resumption of old methods or to the adoption of positive accident-prevention measures, we can't say; but something must be done, for time-saving is no excuse for taking human life.

Business and the Individual

THAT the responsibilities of American business to the individual, the nation, and the world, are increasing more rapidly than ever before was pointed out in an address given some time ago before the Chamber of Commerce of the United States by Julius H. Barnes.

"In this present era of applied invention," said Mr. Barnes, "of trained intelligence, of old industries expanded, checked, or displaced, of whole new industries rising with the magic wand of invention, and of high speed in the creation of wealth and possessions, we have a fluid economic structure that challenges the imagination. The social habits, indeed the individual character of our people, are under the influence of new and vast forces. The scene shifts hourly. The world of everyday has become a fairyland."

In 17 years our national income has increased from 32 billion dollars to 90 billion dollars annually. This is significant because, as Mr. Barnes said, "America has learned that national wealth is the aggregate of individual possession and attainment and that the stimulated production of the individual inevitably builds higher the aggregate of national possession." It is significant also that the relative national wealth of the United States against that of Great Britain is almost the exact relationship of the relative per capita horsepower: 4½ to 1. America possesses two thirds of the world's banking capital and heads the list in per capita ownership of prosperity-producing machinery. Contrast our machinery equipment of 24 dollars per person against, for example, that of Russia of one dollar per person.

Business, in days gone by, may have been ruthless and savagely unjust; nevertheless it is the basis of a public and individual welfare unequaled anywhere in the world. Having outlived the ethics—or lack of them—of past days, American business now has many duties to perform. It must maintain its present high standards and must appraise the background of those forces that induce economic, political, and social changes; for they influence the markets of the world, therefore the wealth of the nation and, consequently, individual welfare. In short, business has responsibilities, the ramifications of which touch every phase of human endeavor, and it must, therefore, maintain public confidence by continued research and progress, service, and unimpeachable ethical standards.

Who Says Hard Boiled?

THE world of science will give a good round cheer when it learns that a public utility company has surrendered five thousand good hard round dollars for the sole purpose of enabling some archeologists to dig up areas behind a newly constructed dam, because these areas are believed to contain Indian artifacts and are about to be flooded. Louder cheers will be added when it is learned that the money was forthcoming without a struggle; in fact, it was voluntarily contributed.

The company in question is the Pennsylvania Water and Power Company, the dam is at Safe Harbor in that state, and the official recipient of the excavation fund is Mr. Frederick A. Godcharles, Curator of the State Library and Museum.

When supposedly "hard-boiled" money-making concerns do things of this kind, and especially when their stockholders permit such diversion of funds without promise of a cent's return, we think it signifies that things are looking up. Enlightenment is spreading, even to the pocketbook.

Naval Conference Problems

AMID surroundings most appropriate for an epochal event, the London Naval Conference came to order; delegations from five great naval powers, assisted by the cordial welcome of King George and the British Government, quickly established a friendly atmosphere conducive to the solution of the various intricate problems confronting them. The leader of each delegation in turn indulged in optimistic generalities, made guarded reference to the naval needs of his state and truthful disclaimers of hostile intent. No new facts were developed or, by the initiated, were expected to be developed; the press of the world had been discussing for months the critical points confronting the delegates; and literally no new facts remained to be revealed.

It is well that these friendly formalities increased the understanding begun by the Hoover-MacDonald conferences on the Rapidan, for as soon as the delegations attempted to translate genial generalizations into concrete categories of ships, the carefully concealed but well known frictions exposed themselves to view. After our long struggle with Great Britain over the cruiser parity it will surprise most Americans to learn that Europe still suspects a secret Anglo-American understanding. Yet such is the persistent European suspicion.

After the conference opened, there was considerable maneuvering for position, similar to the preliminary moves often observed at our national presidential conventions. France seemed to have all the advantage at this stage, until Mr. Stimson stated the American position and Mr. MacDonald followed with the British reaction. Unfortunately the American and British statements appeared to confirm the European impression of an American-British understanding and irritated the French who still remember how they were isolated at the Washington Conference.

(*Please turn to page* 328)

Can the World Banish Malaria?

A Physician's Practical Plan to Rid the World of the Mosquito-Borne Disease; a Plan Which Nearly All Can Test

By THEO. KRYSTO, M. D.

Will You Take a Hand?

PROFESSOR DAVID STARR JORDAN, former head of Stanford University, famous naturalist, expert on mosquitoes in relation to malaria, and Corresponding Editor of this magazine, states that "Dr. Krysto's suggestions may prove of tremendous worth to the world. I think," he writes, "that you will be making no mistake in printing it." We hope to receive in Dr. Krysto's behalf communications from readers who may have noted the peculiar antipathy between the leguminous plants and the organism of malarial fever; also from any who may be led to try out this year the Krysto plan of elimination of the disease—*The Editor.*

I WISH to show the people a way to free themselves of malaria and of human blood sucking mosquitoes. I also want to show that this liberation could be effected easily, cheaply, and in a short time. This is the discovery of a sober physician, made 33 years ago, verified since by hundreds of cases in Europe, Asia, and both Americas, and confirmed by recent discoveries and observations of several authorities. To this I shall add another discovery made by a solid French scientist and confirmed by his conspicuous demonstrations—not in a laboratory but in real life.

Malarial fever is a dreadful, world-wide disease. If you look at the map in a medical geography, you will see that the whole space between 40 degrees north and 30 degrees south is flooded with malarial fever, with the exceptions of dry Australia, the dry western states of the United States, most of Arabia, and Egypt. In some localities almost the whole population is sick with the fever, like many places in Africa, Central and South America, Indo-China, the lowlands of India, and so on. There are in Africa many places where malarial fever kills in 48 hours if medical help does not come in time. Many of us remember a bold challenge of Ravanalona, queen of Madagascar, to the French Government: "I have very few soldiers, but my fevers will decimate your armies very efficiently!"

Millions are sick with malarial fever in acute form, millions are sick with the same fever in chronic form (paludism), and other millions are suffering from blood-sucking mosquitoes. All these sufferings are dispensable. The causes can—and must be—exterminated, eradicated. I know what malarial fever is, for I was sick with it during 19 years.

In fairy tales the treasures are often guarded by colossal genii, immense dragons, powerful goblins, but the treasures of the tropics are guarded by tiny fairies—mosquitoes. They are small, the smallest of them being almost invisible, but they perform their duty wonderfully well. They sting, annoy, and irritate; they poison with the germs of malarial fever, yellow fever, filariosis, elephantiasis, and what not.

The fight between men and mosquitoes is very old and until quite recently the mosquitoes were the conquerors. Some scientists are of the opinion that malarial fever—in other words, mosquitoes—greatly contributed to the downfall of the Roman Empire. At last the scales begin now to turn to man's side. Since the discovery of Sir Ronald Ross, in 1897–'98, that mosquitoes are the propagators of yellow fever and malarial fever, men have begun to fight them more energetically. The Americans have developed quite successful methods,

Courtesy of the United States Bureau of Entomology

A MOSQUITO BREEDING POOL IN DALLAS, TEXAS

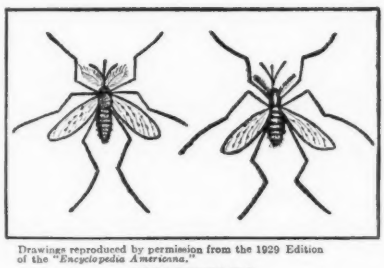
Oiling and draining have greatly reduced malaria, but the author of the accompanying article feels that the attempt thus to cope with malaria will prove impossible of general attainment

which were demonstrated conspicuously at the Panama Canal and in cities of Ecuador and Brazil, the larger cities of the latter country being now almost completely free from mosquitoes and from the fevers.

UNFORTUNATELY these simple and effective measures can not be applied to rural conditions. The main reason for the impossibility is this: In the city every receptacle containing water can be inspected and protected from mosquitoes by wire nets, oil, emulsion, or fishes that eat mosquito larvae. In the country, especially during the rainy season, every small cavity and hole in the ground—imprints of the hoofs of animals, for example—contains water and serves as a breeding place for mosquitoes. Dr. L. O. Howard of the United States Bureau of Entomology relates the observations of W. E. Howorth in Tanganyika, Africa, that mosquitoes even breed high up in the crowns of cocoanut palms. He also cites several authors who observed breeding mosquitoes in tree holes, in cocoanut husks, in the hollows of bamboo stumps, and so on.

Thus it has so far been impossible to free rural localities from man infesting mosquitoes, and therefore from malaria. With the methods which I have the boldness to offer it should be possible.

When Sir Ronald Ross propounded a theory that malarial fever is propagated by mosquitoes, almost everyone laughed at him. Even General Gorgas laughed—the same Gorgas, who, afterward, having adopted the Ross theory,



Drawings reproduced by permission from the 1929 Edition of the "Encyclopedia Americana."

ANOPHELES

The *anopheles* mosquito carries malaria; when it alights its body slopes sharply

put it into practice with such success in Panama, making it possible to dig the Canal.

"The world requires," says Ross, "at least ten years to understand a new idea, however important or simple it may be. The mosquito theorem of malaria was at first ridiculed, and its application to the saving of human life treated with neglect, jealousy, and opposition."

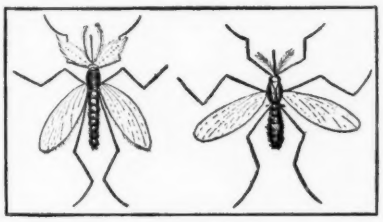
I offer a plan to free the world from malarial fever and from human blood sucking mosquitoes. It is possible that my plan will be also ridiculed. It is, however, so easy to put into practice, so certain to produce the desired results, that I am sure in less than ten years every planter and every farmer, even the least instructed, will make use of it. The use of this plan will assist the tropics in working out their inexhaustible riches.

Thirty-five years ago I lived in the village of Machindjauri, District of Batum, Caucasus, Russia. I noticed that out of 60 inhabitants of the village every one was sick with malarial fever, except four—Sahli Effendi, his wife, and their two children. Analysis of the conditions showed me that Sahli Effendi differed from the other inhabitants of the village only in this: he raised beans for sale in the market at Batum, and alfalfa for his horse. The beans and the alfalfa were grown around his house.

ANOTHER instance. One summer, when malarial fever was raging in Machindjauri, I moved my family to Kvishhety, near Suram, on the Transcaucasian Railroad. This village consists of two parts. The larger part is situated on the slope of a mountain. It is free from malarial fever. The smaller part is situated in the valley of the Kura River, and has a good deal of fever. One of the inhabitants of the lower part of this village, Misho Kipiani, sowed about six acres to alfalfa. As soon as the alfalfa grew up and began to bloom, malarial fever disappeared as if by magic!

These two cases were a point of departure in building my plan of attack. It is known that mosquitoes feed on the juice of plants; the males feed exclusively thus, and the females feed partly on the juice of plants and partly on the blood of animals and men. I found that when *Anopheles*, the malarial fever mosquito, feeds on leguminous plants, their juice neutralizes the noxiousness of the mosquito. It can no longer spread malarial fever. A locality known as the Marshes of Karà-Su (Black Water), near Tiflis, Caucasus, was uninhabitable on account of malarial fever. But the government performed some drainage, people began to come and to sow alfalfa, as alfalfa was in great demand on the Tiflis market, and malarial fever began to diminish. Local scientists and physicians ascribed this diminishing simply to the drainage and the clearing of the underbrush, but *Anopheles* still was present there as before. Many of the mosquitoes were, however, being neutralized by the juice of the alfalfa, and could not spread malaria.

When I was appointed Russian Government Agricultural Commissioner to the United States I had to travel a good deal. Incidental to my special agricultural work, I continued my observations pertaining to my belief. I spent one summer in the southern states, and here I found many facts that confirmed it. I am sorry to state that all my materials—notebooks, photographs, and so on, perished during the Russian revolution and my flight from the Bolsheviks, but I remember several facts like the following. In the midst of the marshes of Arkansas I found a little farm which



CULEX

The common culex mosquito carries no malaria; its body rests horizontally

belonged to an old man. He and his family were well, while all the people around were sick with malarial fever. The cause of this seeming immunity was clear. Beside a field of cotton he had, near his house, a field of alfalfa. His neighbors had only cotton fields.

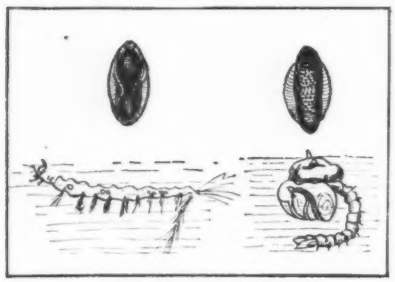
In 1911 I was sent by the Russian Government to Argentine to study some agricultural problems. I was greatly impressed with the remarkable extension of alfalfa growing in that country. Inquiries showed that as soon as alfalfa was sown in some malarial locality, the fever disappeared there at once. Just as in the Caucasus, the inhabitants of the localities explained the disappearance of malarial fever by the fact that these places were cleared. They were cleared, but the mosquitoes were present there as before, but now they were "sterilized" and could not inoculate human beings with the disease.

IN 1912 I was transferred from the Russian Government Agricultural Agency at St. Louis to the Department of Agriculture, Petrogad, Russia. In the summer of that year I was sent to Turkestan, Central Asia, to teach the farmers the California method of fruit-drying. Here I also found innumerable facts in support of my discovery. Wherever there was alfalfa among the orchards and vineyards there was no fever; wherever there were only orchards and vineyards there was fever.

My good friend Mr. I. N. Klingen, former Principal Agriculturist of the Imperial Domains (Udély) in Russia, has communicated to me that by his order in the estates of the Grand Dukes, situated in the districts (*gubernii*) of Orel and Tambov, 60,000 acres were planted to red clover. Previously these localities had many cases of malarial fever, but as soon as clover grew up, malarial fever disappeared there completely. Clover, like alfalfa, is leguminous. Alfalfa, clover, beans—all these and numerous

others belong to the leguminous family and have in common a substance called coumarine. "May coumarine play a rôle in the insects comparable to that which quinine plays in man," says the prominent Yale scientist d'Herelle.

The English edition (1924) of d'Herelle's book, "Immunity in Natural Infectious Disease," contains further confirmation of the theory. On page 187 the author says: "The greater portion of the Argentine Republic is completely free of malaria, in spite of the fact that the *anopheline* carriers abound in these regions where very frequently are to be found human carriers of the plasmodia, who have contracted the disease in the malarial districts."



ANOPHELES

Above: the eggs (top and bottom). Below: the larva or "wiggler;" at right, the pupa

Further, Dr. d'Herelle states, "We have seen that in all of the free regions there is a wild plant . . . called by the natives *'trebol de olor'* (scented clover), belonging to the genus *Melilotus*, probably a local variety of *Melilotus altissima*.

"FLOWERING takes place during the critical period of malaria, that is, from the beginning of summer to the end of autumn. The highly scented blossoms are continually frequented by insects of many kinds, and particularly by *Anophelines*, which feed upon the juice which, like all plants of the genus, contains a glucoside, coumarine. This plant is not present in malarial districts."

On page 188 we read this: "Recently, while living in Holland, I have sought the cause of the disappearance of malaria, as has been noted for about 20 years, from certain islands of Zealand and from northern provinces of Holland. In these two regions the disappearance of malaria coincided with the accidental introduction of plants of the genus *Melilotus* . . . Malaria has, on the contrary, continued to ravage certain of the Zealand islands where . . . the *Melilotus* has not been introduced."

I was equally much pleased to find in the *Literary Digest*, Volume 98, Number 4, page 17, the following abstract from the pamphlets of Sir William Willcocks, engineer of Cairo, Egypt: "Cultivated Egypt is mainly immune from malaria, and cultivated Egypt means Egypt with all its wealth of clovers, leguminous plants, wild melilotus, and trigonella. But where tracts of Egypt have been planted with fruits or other crops instead of clover, there malaria devastates the population as it does in Palestine and Greece, where there are few leguminous crops and in those parts of India where *gram*, a kind of chick-pea, is not cultivated."

You see that all three of us came independently to the same conclusion. And all three of us have traveled widely so that we could observe the confirmations of the theory in different localities of Europe, Asia, Africa, and America.

All this gives me a support to an affirmation that my theory could be applied *consciously* in any malarial locality, as it was applied *unconsciously* in the localities mentioned above. We can introduce leguminous plants, with the intention of disinfecting *Anopheles*, the malarial mosquito, either as fodder, as manure, or as decoration. Some of these leguminous plants are flowers and some are large, shady trees, but all of them have, as is well known, the property of gathering nitrogen from the air by means of the nodules on the ends of their roots.

THIS is the first part of my plan. The second part consists of replacing mosquitoes which suck the blood of human beings by mosquitoes which suck the blood only of animals.

In the *Comptes Rendus de l'Academie des Sciences*, Paris, France, for the year 1924, 1927*, and 1929, there are some very interesting articles by a French naturalist, J. Legendre. As he states, there are some mosquitoes that do not sting men. There are also some mosquitoes whose larvae eat the larvae of another mosquito, and in this way exterminate them from a given locality. M. Legendre has discovered in Brittany a mosquito—he calls it *Breton culex*—which crowds out another breed of *Culex* mosquitoes, and at the same time does not sting men but only animals.

In July 1923, M. Legendre transported eggs and larvae of *Breton culex* from the place of its habitation to Pons, where swarms of *Culex pipiens* and *Culex hortensis* annoyed the people. In the summer of 1924 M. Legendre did not find these mosquitoes there. They were replaced by *Breton culex*. These mosquitoes, hatched in proximity to the habitations, did not sting children or adults but only chickens and probably wild birds. M. Legendre continued his observations in 1928, and found out that *Breton culex* had held its own, and continued to be "man-hating" in the new locality.

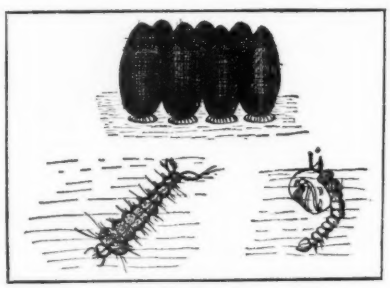
A proprietor of a farm near Pons asked M. Legendre to free him from annoying mosquitoes. M. Legendre introduced his *Breton culex*, and in one month they crowded out the aboriginal mosquitoes.

M. Legendre also discovered in several localities in France a variety of *Anopheles maculipennis* mosquito which does not sting men. Curiously enough, these mosquitoes and *Breton culex* live together in some localities as good neighbors, having no tendency to crowd one another out. M. Legendre thinks it would be well to introduce both of these races into localities where there are malarial fever and human blood sucking mosquitoes.

While the first part of the proposed method—the use of leguminous plants—is a novelty, the second part is a new departure from the ordinary use of insects to fight other insects which are injurious; lady birds against aphis and scales, for example. These natural methods are mostly far superior and preferable to artificial ones, and, especially, far less expensive. But the use of oil and emulsions in rural conditions is inadequate.

So, let us take leguminous plants and friendly mosquitoes and start our work of liberation. We may start our work on the island of Cuba. I choose it for many reasons, the main one having to do with the acclimatization of the mosquitoes themselves. Insects, like plants and animals, must be acclimatized gradually, step by step. Cuba could be followed by Paraguay, Brazil, and Central America.

I have outlined, rather briefly it is true, the salient parts of the plan for ridding the world of the malarial fever mosquito *Anopheles*, though I have not here touched on its humanitarian aspects or indeed on its economic aspects. It might be said that malarial fever costs the world millions in loss of productivity alone, but a definite estimate would force us to talk in terms not merely of millions but of billions.

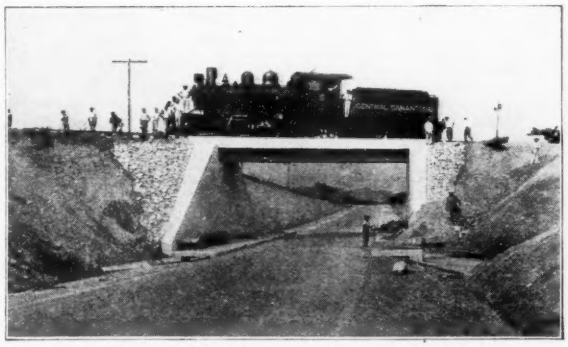


CULEX

Above are the eggs of the *culex*, laid in masses, and below are the larva and pupa

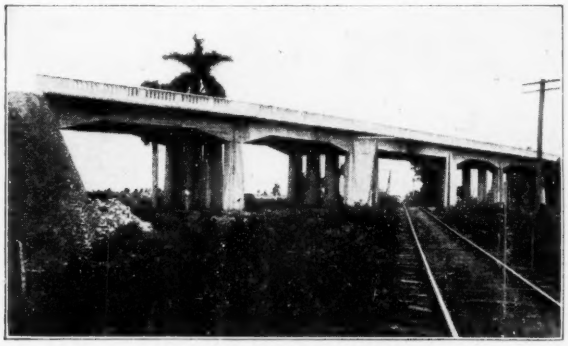
I hope that among 120,000,000 Americans there will be found one who can lend a helping hand to this enterprise.

*The article of 1927 was abstracted in the *Literary Digest* for March 31, 1928.



THE NEW HIGHWAY AT AN UNDERPASS

The sub-grade is surmounted by 12 inches of heavy rock, then a layer of concrete from six to nine inches in depth. This is topped by a two-inch bitulithic covering of special composition



ONE OF THE 25 OVERPASSES

Outside the towns, the highway is about 20 feet in width with a 5.64 foot shoulder on either side. In towns the width is about 26 feet. Note the massive construction for withstanding storms

Cuba Builds a Model Highway

Work Is Progressing on This 700-Mile Highway, in Which All Grade Crossings Are Eliminated

By HAMILTON M. WRIGHT

CONSTRUCTION on the 700-mile Cuban Central Highway is now 59 percent completed, according to W. C. McDonald, manager of the Cuban operations for Warren Brothers Company, of Boston, which is constructing 500 miles of the road. The remaining 200 miles, in the Matanzas and Santa Clara provinces, are being constructed by the Associated Cuban Contractors, Inc.

One of the outstanding features of this arterial highway is that there will be no intersections with railroads. It is believed to be the only great national highway on which grade crossings have been eliminated entirely. In seven instances, the highway passes beneath the railway tracks, and in 25 it crosses above them.

There are no grades exceeding 5 percent, and no turns with more than 4 percent curvature. A large number of costly fills and cuts have been necessary to maintain a direct route in the rugged country traversed. The total cost of the road was originally estimated at 75,680,000 dollars, but extensions since authorized have raised the cost to approximately 100 million. Already about 60 million dollars has been expended.

Approximately 11,000 men are employed in the winter season, when the work is not hampered by torrential rains. Of these, about 8000 are employed by Warren Brothers Company. This firm has introduced about 2,500,000 dollars worth of road-making equipment.

At present it is possible to ride about 75 miles east or west of Havana on the new highway. It is expected that the road from Havana to the city of Pinar del Rio will be opened on May 20th, the 28th anniversary of the establishment of the Cuban Republic. It will also be open from Havana to Santa Clara by that time, according to expectations. In the summer of 1930, the road is scheduled to be open from Havana to Camaguey. Mountainous sections of the road in Oriente Province have been completed, but the final opening of the road to Santiago de Cuba will probably occur late in the spring of 1931.

FLOOD PROTECTION

This Tilford rock fill at Madruga passes over a valley which often is flooded

CUBA'S NEW HUNDRED MILLION DOLLAR HIGHWAY

This great highway follows the "backbone" of the island nearly from end to end. It will provide an outlet for 185 sugar plantations, and passes through country noted for its magnificent tropical scenery. American motorists will reach Cuba by ferry-boat from Key West

The Two April Eclipses

Astronomers Will Make Full Preparation, Even Though the Coming Solar Eclipse Will Last Only Two Seconds

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE month of April is notable for the occurrence of two eclipses, one on the 12th-13th and one on the 28th, both of which are visible throughout the whole extent of the United States. The first is a partial eclipse of the moon which happens on the night of the 12th and early morning of the 13th. At this time the moon passes far to the north of the center of the earth's shadow, so that only one ninth of her diameter is immersed in it, even at the greatest phase. Were her track only 250 miles higher above the plane of the ecliptic she would escape eclipse altogether.

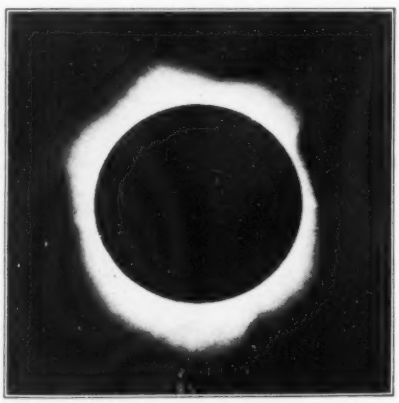
The moon enters the penumbra of the earth's shadow at 10:43 P.M., Eastern Standard Time. At this moment an observer at the proper point of the moon's surface, on what looks to us as her southeastern edge, would see the earth just begin to trespass on the sun's disk and cut a small notch in it. The terrestrial observer watching the moon will notice nothing at all, for at this first moment the brightness of the sunlight which illuminates the moon will be decreased by only an infinitesimal amount. Half an hour or so later, when the earth has hidden a considerable part of the sun from our hypothetical lunar observer, the gazer from the earth may notice that the southeastern side of the moon is not as bright as the rest, and before midnight this change will be conspicuous.

FINALLY, at 12:21 A.M. on the 13th, the moon's edge reaches the true shadow or umbra. For a lunar observer at this point the sun would disappear behind the earth, while the terrestrial watcher will see the dark shadow beginning to cut a notch in the moon's limb. To the naked eye the edge of the shadow seems sharp, but a field glass, and much more a telescope, will show that it is hazy and indefinite. This is natural since it is the shadow of the earth's atmosphere and not of its solid surface.

On the present occasion when only a small part of the moon's edge is shadowed, the obscured portion will be almost invisible, but this is mainly an effect of contrast with the bright part of the disk. In eclipses of greater magnitude, and especially in total eclipses, the whole body of the moon remains visible, illuminated faintly by light which has been reflected by the earth's atmosphere—just as a concave lens bends light inward. Our imaginary lunarian would at this time see the earth rimmed by a narrow but brilliant line of light, brightest at the point on the edge which was nearest to the hidden sun, tinged with the colors of the sunset, interrupted here and there by gaps where clouds impeded the free passage of the rays. Little of this will, however, be visible at the present time.

ECLIPSE RECORD-HOLDER

Professor J. A. Miller, Swarthmore astronomer, has never lost an eclipse because of cloudy skies. Nine times he has journeyed to witness total eclipses—nine times been rewarded. Other astronomers, joking, perhaps envious, accuse him of having a "pull" with the weather



ECLIPSE OF 1929

Taken with the Navy's telescope camera, Philippines, May 9, 1929. Furnished by Theodore Michelson, one of our readers

At 12:58 A.M. the eclipse area reaches its maximum and at 1:36 the shadow withdraws. The moon is not out of the penumbra until 3:15 A.M. but the last stages of its exit, like the first of its approach, will be imperceptible.

Of much greater interest and importance is the solar eclipse of April 28th. This is described in the *Nautical Almanac* as a "central" eclipse, since it is total at some points along the shadow track, and annular in others and can not therefore be called by either name.

It may be remembered that when the moon is nearest the earth her shadow extends beyond us. When it strikes the earth's surface it forms a small dark spot, never more than about 160 miles in diameter, from which all sunlight is excluded (Figure 1). An earthly observer anywhere within this region will see at the given moment the moon completely hiding the sun and outlined black against the corona.

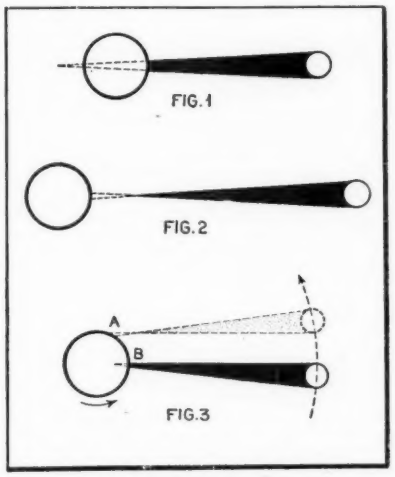
BUT if the moon is farther off than the average her shadow tapers to a point before it reaches the earth, and there is no point on the earth's surface from which all sunlight is cut off. An observer right in line with the moon and sun will see the former centered exactly on the latter but exhibiting a smaller disk, so that a narrow bright ring of the sun sticks out all around and produces an annular eclipse. (Figure 2).

Once in a while, however, the moon's distance may be intermediate, so that the point of the shadow falls short of the earth's center but is nevertheless able to reach its surface which is almost 4000 miles nearer. In such a case an observer on the central line near the ends of the shadow track (A in Figure 3) will see an annular eclipse, while for one at B, near the middle of the path, it will be total. This is what happens on the 28th. The tip of the shadow cone reaches at most only about 70 miles beyond the earth's surface, so that the eclipse is annular over most of its course but total for a small part in the middle.

Starting far out in the Pacific the line of central eclipse passes some 500 miles south of Hawaii. The eclipse becomes total shortly before its track reaches the Californian coast which it

attains at a point about ten miles north of San Francisco. Its motion here is almost due northeast and takes it diagonally across northern California, northwestern Nevada, the southeastern corner of Oregon and through Idaho and Montana into Canada. Shortly after crossing into Montana the eclipse loses its total character and the annular phase is visible along the rest of the track which crosses Hudson Bay and Labrador and leaves the earth in the Atlantic south of Iceland and west of Ireland.

A partial eclipse can be seen in a wide belt on each side of the central line extending northward to Alaska, Siberia, Greenland, and the Pole, southward to Yucatan and Cuba and eastward to Scotland and Ireland where the sun sets eclipsed.



ECLIPSE OF APRIL 28

Figure 1 illustrates a common total eclipse, *Figure 2* an annular eclipse, and *Figure 3* peculiar conditions on April 28

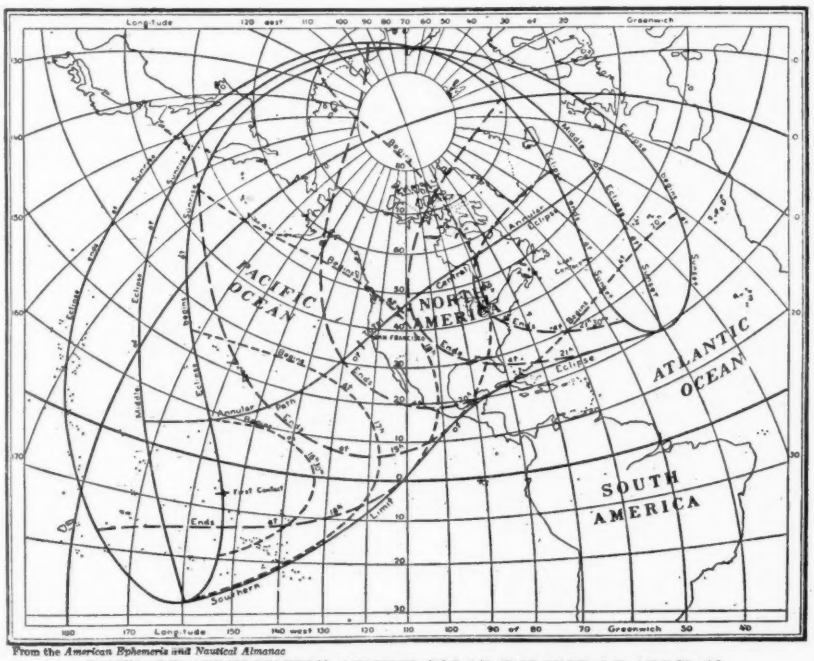
THE magnitude of the greatest eclipse is of course more than 99 percent at San Francisco and is more than 80 percent along the whole Pacific Coast from Seattle to San Diego. Chicago sees a maximum eclipse of 64 percent, New York 54 percent, New Orleans 30 percent, and southern Florida only half as much.

The total phase is longest in Nevada, but even there it lasts only a second and a half. The moon's shadow has tapered to a diameter of less than three quarters of a mile at a point where it reaches the earth, and this goes by very quickly. For the same reason the eclipse track is so narrow that great care will be necessary in picking out observing stations. In spite of this almost absurdly short duration the eclipse is likely to be well observed. Its track leads through a readily accessible country, near noon, when the sun is high, and it comes at a season when the chance of fair weather, especially in the Nevada deserts, is very good.

It may appear remarkable that anyone should go to the expense of a journey across the Sierras to spend less than two seconds in observation, but there are some problems for the study of which this eclipse is distinctly favorable.

At the moment of totality only the actual photosphere of the sun will be hidden—indeed it may even peep out here and there through the gaps between the lunar mountains. All the overlying layers of the sun's atmosphere will be fully visible, and spectroscopic observations taken with automatic photographic devices during the critical seconds may give data of much interest and importance.

Another problem which may well be attacked is that of the light of the part of the sun's disk close to its edge. It is well known that the limb of the sun is not nearly as bright as the center. To follow the fall of brightness up to within 1 or 2 percent of the distance from the center to the edge is not difficult, but in the last 2 percent of the distance the brightness falls off very rapidly and all sorts of complications arise when measures are attempted with a full sun. Scattered light in the instruments, and the trembling of the image due to "bad seeing," make the observations very troublesome. But, when the moon eclipses the sun, all that needs to be done is to measure the brightness of the remaining sunlight during the partial phases, and the problem is then one which the mathematician can easily solve. At the present eclipse the sun's light will fall off very fast indeed during the last few seconds before totality, and come back again with equal rapidity. Some automatic registering device, doubtless photographic, would have to be employed. If one is available we may learn much more than we know now about the brightness of the sun's edge; and this knowledge will be of much importance in testing the theories which are rapidly growing up regarding the sun's surface.



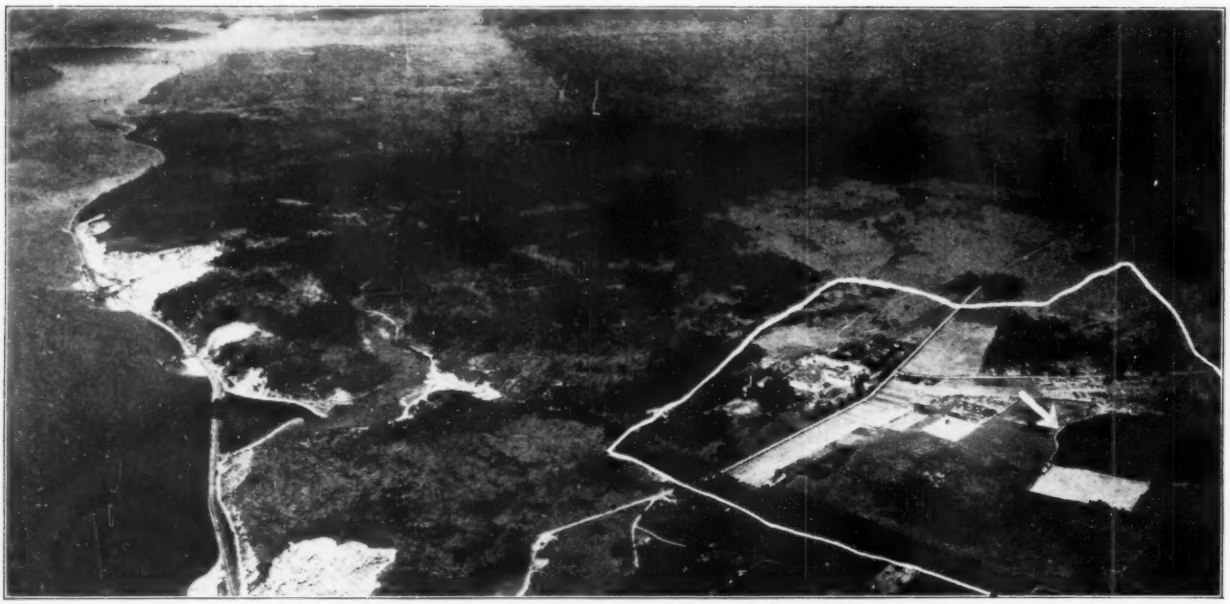
From the *American Ephemeris and Nautical Almanac*

DATA OR "ELEMENTS" OF THE SOLAR ECLIPSE OF APRIL 28

The center line of the eclipse extends diagonally from lower left toward upper right. The other elements may be studied out from the drawing itself, by the especially interested reader

SO much for the professional observer. But will it pay the sightseer to go out of his way to look at this eclipse? Most assuredly. There will be time for only a fleeting glimpse of the corona. Indeed there may be so much light in the sky as to drown out all but the inner portions of it. But the advance of the shadow, coming like a narrow beam of blackness from the southwest, should be spectacular. At the crowning instant when it passes over in a "flash of blackness" the sun may appear as a ring of dazzling points of light interrupted by the mountains along the moon's edge. Something of this sort was seen at the last similar central eclipse, the track of which passed near Paris a year or two before the war. We may trust Californians not to miss the sight when they have the chance.

The location of the track along which this phenomenon was visible should fix with great precision the line of central eclipse, and this again will give precious information to the theoretical worker. All told, the eclipse will abundantly repay both the observer and the sightseer, and it is to be hoped that it will be well watched.—*Rome, Italy, December, 1929.*



SITE OF THE EXPERIMENT IN RECLAMATION-FERTILIZATION

The irregular area outlined in white in the lower right hand corner is the Western Washington Hospital grounds. The arrow points to the small lake, the bed of which was covered with a heavy vegetable humus. Tacoma is in the haze of the background

Land Reclamation By Silting

Natural Humus Is Pumped, in Suspension, From Lake Bed Onto Gravelly Soil, Resulting in Extraordinary Fertilization

By CHARLES F. A. MANN

A UNIQUE and one of the most successful of the many reclamation schemes in use on the arid lands of the west was originated by Dr. Charles E. Taylor, superintendent of the Western Washington Hospital, located near Tacoma, Washington, on the farm lands of the institution.

This hospital, the largest operated by the State, was established shortly after Washington was admitted into the Union. Because of its proximity to the densely populated area bordering on Puget Sound, this location was chosen despite the fact that the entire area is part of an immense glacial moraine, left by a mighty glacier that at one time swept southwesterly down the slopes of Mt. Ranier-Tacoma and emptied its icebergs into the deep waters of Puget Sound. Cultivation of crops on the loose sandy soil of this area has long been a hopeless task, requiring excessive application of black dirt and water to form a soil that would nourish plants as well as hold moisture.

Some idea of this peculiar formation may be gained by consideration of the fact that one of the world's largest gravel pits is operated at tidewater, just two miles below the hospital, which is at an elevation of about 400 feet. Test borings indicate that this glacial deposit, on which part of the city of Tacoma, as well as the institution, is situated, is from 300 to 900 feet deep and of unusually uniform size. The sand is nearly all of white quartz-silica composition.

UPON assuming charge of the institution several years ago, Dr. Taylor at once set about to discover means to improve the general productiveness of the 700-acre farm operated by patients of the institution, from which a major portion of its food supply is derived. For years the institution had taken many prizes from its displays at local agricultural fairs, but these prize crops were all grown by a patient in his small garden situated near the shores of Waughop Lake, from whence comes the irrigation water supply used during summer months. Dr. Taylor found that this man was mixing his garden soil with a blackish pasty substance which he dug from the shores of the lake when excessive pumping had lowered its surface during summer months.

Tests of the composition on this deposit showed it to be a pure vegetable mold, of bluish green color, that had been accumulating for centuries on the bottom of the lake. Since its decay had taken place under water, practically all of its mineral content had been retained. It is of almost powdery fineness, a small quantity shaken with water requiring over 30 hours to settle out. In its lower strata it took the formation of a thick vegetable jelly. Tests with iron piping driven into the bottom showed the deposit to be nearly 200 feet thick.

Tracing the course of the glacial moraine, scientists have found it to be about 24 miles wide at its widest part, running inland into the rocky foothills of Mt. Ranier-Tacoma for a distance of about 45 miles. The sudden termination of the deposit in these foothills is explained by the fact that the 14,408-foot volcanic cone was at one time about 3000 feet higher; a gigantic explosion, which must have made the explosion of Krakatoa in Java Strait in modern times a puny affair, scattered the entire top and its masses of ice over a very wide area. Because of the heavy precipitation on the mountain and the higher altitude of the older cone, the ice-pack was forced clear to tidewater, carrying its burden of pulverized rock and sand with it. At the present time many small lakes are scattered over its surface, yet only in very recent times have scrub oak and the persistent Douglas Fir with its flat, fan-like root structure, gained a

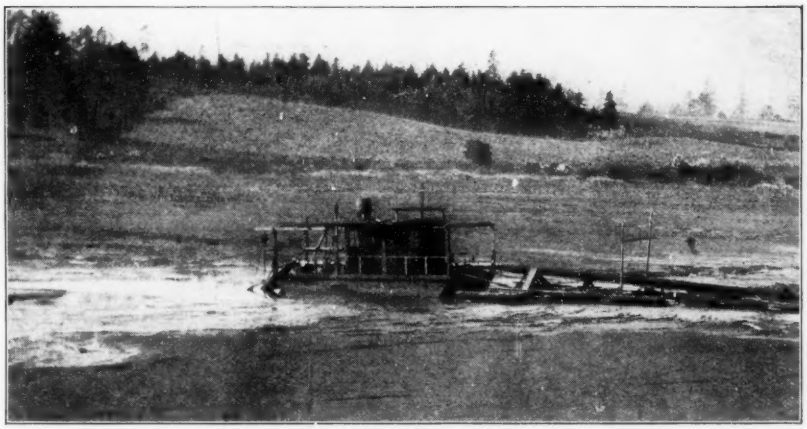
foothold on the loose sandy soil.

Traces of the one-time glacier have manifested themselves in freakish ways throughout the area. In the northern part of Thurston County there is an area of ground covered with peculiar mounds of gravel. On the soil of these mounds, for the presence of which no explanation can be made, only buttercups and coarse grass grow for a short while each spring, although on the heavy clay of Tacoma nearby, plant growth is luxuriant the year 'round.

After careful study, Dr. Taylor found that many of the lakes over this section had similar deposits of the soft mold, which accounted for water remaining on the sandy soil. It is commonly believed by people living on the shores of these lakes that any attempt to drain the lakes in order to remove snags and stumps will break this seal and ruin the property. Real-estate developers are always poetic about describing the virtues and picturesqueness of the snags and stumps, so the lakes are never drained for cleaning.

IF small-scale use of this deposit as fertilizer and binder was successful, why not use it on a large scale and test its merits on a public farm? Thus would be proved for the small farmer the possibility of using land that is not worth over 25 dollars per acre for crops in its present state. Dr. Taylor also wondered whether the lake, which is about 30 acres in extent, was not fed by springs instead of merely being a drainage pocket for rainwater. Accordingly, plans were made for placing the irrigation pump on a barge near the center of the lake.

Early in 1927 the pump was started, delivering 300 gallons per minute, and by autumn the lake was dry. The object was to expose the mud until it was hard enough to shovel out onto trucks. When the bottom was exposed it was discovered that three springs with an inflow of about 150 gallons per minute kept the bottom stirred up and continually wet. Tests of the fresh mud rising to the surface showed that it was fine enough to be pumped through the entire irrigation system, even through sprinklers with quarter-inch nozzles!



PUMPING THE FERTILIZING MUCK

When the lake was drained, it was found that the bed did not dry out because of several springs. This pumping station was installed to pump the humus-filled water over the land

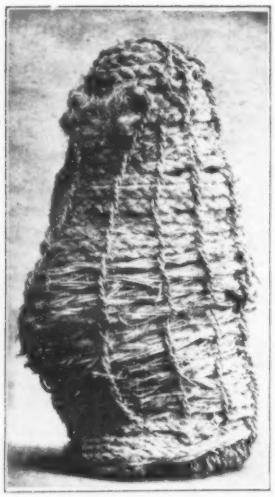
With one stroke it was possible to eliminate expensive hauling of the heavy black dirt from the valleys below and to irrigate the land and spread the mud which both sealed the loose sandy formation and fertilized it at the same time—all in one operation. The swiftly revolving blades of the centrifugal pump, which was driven by a 12-horsepower motor, using current costing nine cents per hour, helped to mash the small lumps of the blue ooze. Soon the material was pouring over the fields through sprinklers and irrigation ditches at the rate of 150 gallons per minute. It had the consistency of thick pea soup. The water soon filtered into the sand, leaving the fresh humus to mix with the topsoil. Steady flow of the springs during the year made it possible to spread a four-inch deposit on the entire farm. Dr. Taylor points out that there is still no explanation for the existence of vegetable matter in the lake unless it was caused by the constant drifting of grass and leaves which dropped into the three-sided pocket.

To the astonishment of agriculturists at the Western Washington station in Puyallup, three crops of alfalfa were grown on a field during 1928. Puget Sound climate was supposed to be bad for this crop, with most of its growing centered in the volcanic ash soils of eastern Washington. Cabbage was grown where even fir trees previously had a hard struggle. Celery grew three feet high last year, on soil that formerly would not support plain grass. In 1927, 13 acres devoted to corn yielded 148 tons. In 1928, over 200 tons came from the same patch. Costs for fertilizer and soil hauling were cut to a quarter those of former years, and with increased yields. Rutabaga turnips for stock feeding reached 10 to 16 pounds in size.

THE SPLENDID RESULTS

In the foreground is a fine growth of cabbage on sandy soil that, previously, was practically worthless. The firs were planted 40 years ago and won't grow higher due to sandy soil

THE success of Dr. Taylor's experiment has attracted wide attention throughout the northwest and it is believed that further projects will be undertaken to utilize the properties of this vegetable mold that is so widely deposited in western mountain and hillside lakes. Costs are limited to pump, power, and labor for digging ditches or running pipelines. Countless thousands of level prairies that are adjacent to lake deposits such as this, are scattered over the west. Application of water alone to these areas would be without result, but the practicability of obtaining this vegetable humus from these natural storehouses and supplying it to the soil, would open up an entirely new field for application of the principles of reclamation on a restorative scale.



What Mummies Reveal

X-ray Studies of Peruvian Mummies Show Us the Injuries and Diseases From Which the Ancient Civilized Indians Suffered

By ROY L. MOODIE, Ph.D.*
One-time Anatomist, College of Medicine, University of Illinois

AMERICAN mummies have never received the attention accorded those from Egypt. They are neither so ancient nor so numerous as those found along the Nile, nor did mummification in the Western Hemisphere have such an important influence on the daily life of the people as it did in the land of the pyramids for thousands of years. During that period the elaborate embalming processes and the preparation and care of the tomb developed into a widespread industry which furnished employment for a considerable part of the population, including many of high professional training.

Mummies of one kind or another are known from isolated areas throughout that vast stretch of territory extending from Alaska to Patagonia, but are confined largely to the Pacific Coast. Nowhere in this area, however, did the preparation of human mummies attain the height it did in Egypt. There all of the sacred animals were also embalmed. This provides us with quite an insight into that country's vertebrate fauna. No animal mummies were prepared in the Americas.

THE nearest approach to the Egyptian mummification of the human dead was that which developed within the boundaries of pre-Columbian Peru, the empire of the royal Incas, where for hundreds of years great care was shown in the preparation of the dead. Recent studies of the ancient Peruvian mummies by the microscope, by the X ray, by the study of the dry bones of disrupted mummy-packs and by a search into their surroundings, have revealed a great deal of interesting information regarding the life of those times when the mummified bodies were the actors of life's drama.

MUMMY PACKS
The packs served as coffins, there being no further protective covering. The one at the top, 33 inches long, is of plaited straw

It is said by early writers that great care was exercised in the preparation of the dead of the Inca household and that the mummies were brought out on feast days to share in the favor of their superior beings. Yet not one single royal mummy from ancient Peru is known today. This is in the greatest contrast to the royal mummies of Egypt. A large folio catalog is required to contain the descriptions of those preserved in the Cario Museum.

Little is known about the preparation of mummies in pre-Columbian Peru. We are pretty sure that the body was never opened for this purpose, as it commonly was in Egypt, yet there were skillful surgeons in Peru. Embalming materials, such as resins, astringents, gums, and so on, were known in early Peru, but we are not sure whether they were used. Sun-drying was probably the most common method.

The greatest care was often exercised in the preparation of the mummy wrappings. Often, on the other hand, this was carelessly and heedlessly done. The sarcophagus and the coffin were unknown, nor were the tombs so elaborate as in Egypt. Many of the Peruvian mummies, after careful wrapping, were buried in the sands of the desert, or placed in fissures, in shallow recesses, or in deep caverns. Nowhere in Peru was a tomb chiselled from the rocks, although they did employ certain pyramid-like structures built of mud bricks.

THE wrappings, of beautifully woven and decorated cloth, of dressed skins, feather blankets, or of coarsely woven materials and even of native grasses, do not display the complicated arrangements and writings of Egypt, nor do these materials ever indicate foreign trade. But they do connote some degree of commerce between the coastal and mountainous regions of ancient Peruvian times. The colors of bird feathers such as those of the flamingo and of the macaws are perfectly retained after resting for a period of many centuries in the desert sands.

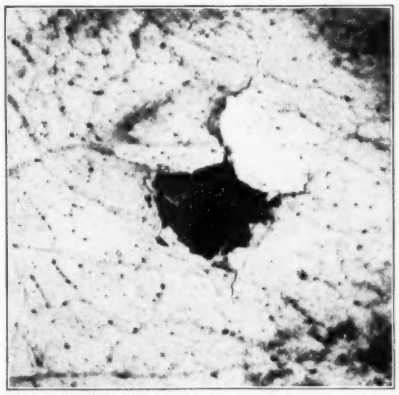
The mummy packs of Peru are unlike those of any other area. Often the huge bundle, gorgeously decorated and elaborately equipped, shows a false head, with features indicated by plaques of silver or other materials sewn on the face of the false head. One, two, or three bodies may be enclosed in the same bundle. Sometimes the X ray shows the mummy upside down in the pack. A pre-Columbian pack in Field Museum at Chicago contains father, mother, and child. Raw cotton, abundantly grown in prehistoric Peru, was used in quantities in the wrappings of the bodies. The greatest variety of appearances in the mummy-packs is found in different areas. A few of them are shown here.

*See "Among Our Contributors," page 261.

The medical interest attached to the nature of these ancient mummies is very great. The X ray shows wide ranges of the diseases and injuries to the bones. The microscope supplements these findings by showing minute alterations in the walls of blood vessels, common to the hardening of the arteries. Diseases of the teeth are likewise revealed, and the evidence shows the ancient Peruvians to have been sufferers from many chronic ailments. A few of the mummies show trephinings of the head, a surgical procedure at which the pre-Columbian Peruvians were adept. It is a matter of surprise to learn how infrequently trephinings are found in the heads preserved in the mummy packs. This leads us to the query as to why trephining was so common in Peru.

The relief of pain due to depressed fractures of the cranium, following sling-shot injuries, was doubtless the greatest single cause of trephining, though of course there were other causes. The sling shot was the one most important single weapon of war. The slings were beautifully woven of wool, and were decorated. Hence they served also as an ornament to be wrapped around the head when not in use. The distance and accuracy with which rounded pebbles could be thrown is amazing. Since such injuries as depressed fractures were received more often by soldiers, it is thought that trephinings were done as a military measure to conserve the man power of the state.

The number of infant and youthful mummies is appalling. These often had received the briefest care, as shown in an accompanying figure. While our study of pre-Columbian pediatrics in Peru, as shown by the X ray, is still incomplete, yet it has gone sufficiently far to give us a fair cross-section of such maladies whose evidences would be visible in the skeleton, had they been present. Such a cross-section reveals an astonishing paucity of infantile troubles, showing a much greater degree of health than a similar cross-section of our own infant population would show. Rickets is surprisingly absent. Not a trace of it can be found. It is, of course, evident in these individuals that death was due to some digestive, febrile or other factor of neglect, having no effect on the skeleton.



Courtesy San Diego Museum

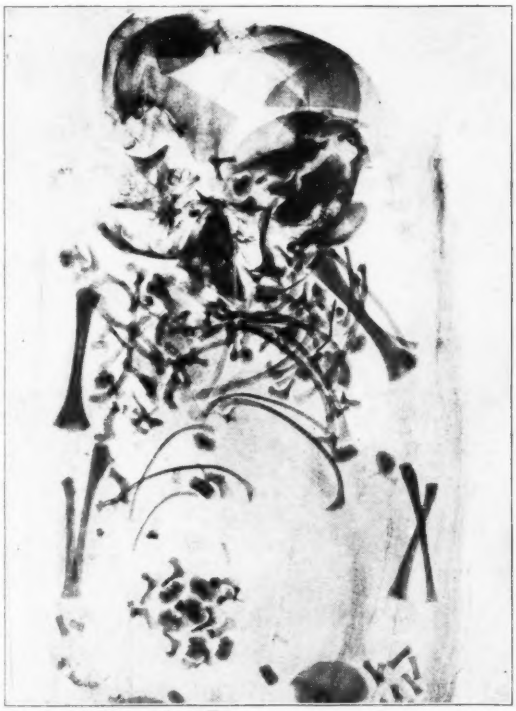
INSTANT DEATH

Effect of impact of sling-shot pebble, seen from within skull of a child of eight

Courtesy San Diego Museum

MUMMY OF AN INFANT

The tissues are well preserved and may be softened and examined microscopically



Courtesy Field Museum of Natural History

X RAY OF INFANT'S MUMMY

Usually in infant mummy packs the bones are greatly disarranged. The wrappings show in faint strands

Vandalism has been the one most important factor in the loss of myriads of objects of the greatest archeological and anthropological interest, ruthlessly destroyed by treasure hunters throughout the ages. Egypt and Peru have shared alike in this. It is said that King Tut is the only royal personage of Egypt whose mummy had not been plundered. The Egyptian mummies had often been roughly broken up to secure objects of value. Similarly in Peru destruction has gone on, in spite of governmental mandates. We must read the story of the mummies from what is left of them.

Wrapped in the ancient mummy-packs are often found various ornaments, ears of maize, shells, dried food plants, packages of coca leaves, the native plant whose stimulating leaves commonly were chewed by the modern Indians. Associated with the burials are skeletons of the domesticated Inca dog and guinea pig. Thus we know what the food of these ancient people had been.

The nature of the ancient Peruvian mummies bespeaks a civilization which carried with it respect and care for the dead. Their woven and decorated winding cloths tell of a highly developed textile industry involving the agricultural care of the cotton and of wool-bearing animals, small camels which still serve the people of the Andes.

The religious motives underlying mummification in Peru are more obscure than in Egypt where the larger part of life was a preparation for the hereafter. We can but feel that we still have much to learn about those ancient folk whose mummies suggest unguessed thoughts and actions.

A STUDY of pre-Columbian pediatrics of Peru is now being carried on in Chicago at and by the Field Museum of Natural History where the large collection of prehistoric mummy packs of scores of infants and older children are being examined under the X ray. Some of the small mummies were simply dried and laid away without wrapping, as is shown in one of our illustrations. Unfortunately we are

Courtesy Field Museum of Natural History

HEAD UNDER X RAY

The skull shows the effects of a heavy smashing fatal blow from a metal mace

hampered in this study by the failure of the X ray to reveal all evidences of disease. This gap is to be filled, however, by examination of the bones themselves. These are to be found in profusion about the sites of prehistoric cemeteries in the coastal deserts of Peru and in caverns and rock shelters in the highlands.

IT is, of course, evident that we are restricted in our search for evidences of diseases to those which make a definite change in the skeleton. A study of the soft parts by the microscope has yet to be undertaken. Water on the brain, called *hydrocephalus*, in its advanced stages causing a perceptible swelling of a characteristic type, has been detected in a few of the infant mummies in Field Museum.

The commonest disease of ancient Peruvian children was a nutritional disturbance whose effects (see illustrations) are known as *osteoporosis*. It is thought that this disease does not occur in America at the present time; or if it does it is rare. There are scant evidences of its occurrence among ancient Egyptian children, but it was extremely prevalent within the past century among the children of the island of Socotra in the Red Sea. Its bony manifestations occur in symmetrical patches at the backs of the eye sockets, on the bones of the skull, inside and outside, but are not known elsewhere in the body.

Under the paternal form of government instituted by the Incas in pre-Columbian Peru, children were well cared for but even at that time life in the higher Andes was hard. The perpetual cold, scarcity of fuel, absence of any attempt at personal cleanliness and, doubtless very often, parental neglect, are all antagonistic factors to which were due the high infant mortality. The children were savages, of course, and adepts with the sling, so we may account for such fatal injuries as shown in one of the illustrations as the results of childish squabbles.

Although the surgical operation of trephining was extremely prevalent in pre-Columbian Peru, no child younger than 15 was ever operated on, among the many hundreds of trephined skulls which have been studied.

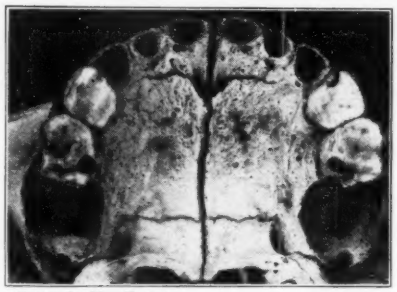
The teeth of the children in ancient Peru were usually sound and healthy. A few cases of cavity formation or dental caries have been seen in milk teeth. Shortly after the eruption of the permanent teeth, however, destructive processes were under way. Caries, pyorrhea, accompanied by huge deposits of tartar, abscesses, and other infections resulted in the loss of many of the teeth early in life and the loss of all of them later. Many an ancient Peruvian "gummed it" after he was 40 years of age. Only one perfect set of teeth from pre-Columbian Peru exists among a collection of 300 skulls in the San Diego Museum. Wisdom teeth seldom erupted and but four examples of impaction are known. No phase of dental surgery was understood or practiced in ancient Peru.

Only a beginning at pre-Columbian pediatrics has been made, but the progress already made is encouraging. A study of food substances in pre-Columbian Peru, now under way, will aid considerably in appreciating childhood life under the reign of the Incas and the pre-Incas of South America.

OSTEOPOROSIS

Osteoporosis or "bone porousness" was the commonest disease of childhood. The backs of the eye sockets are favorite places for this disease

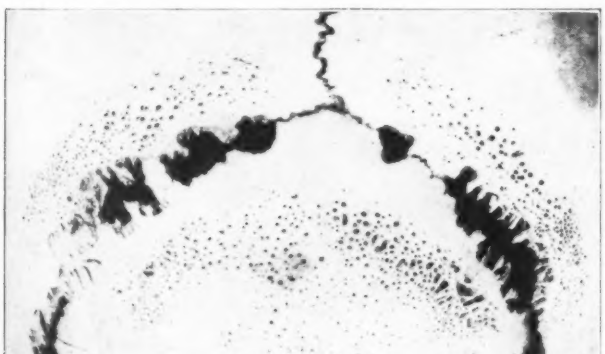
Courtesy San Diego Museum



Courtesy San Diego Museum

EXTINCT TOOTHACHES

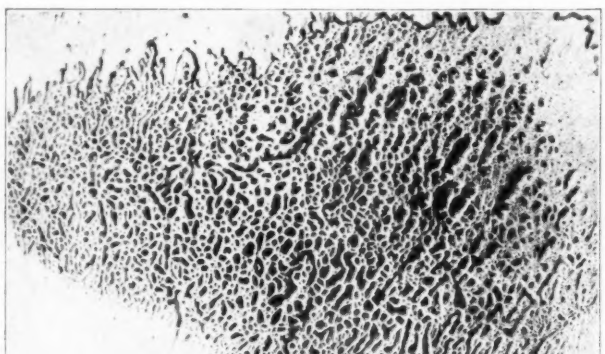
Milk teeth of children show cavities. Pyorrhea and abscesses were also common



Courtesy San Diego Museum

MORE BONE POROUSNESS

This is the top of a skull and shows the nutritional disease of osteoporosis along the wavy sutures or joint lines of the cranium



LACELIKE OPEN WORK—OSTEOPOROSIS

The disease results in patches of perforations. This child had reached the age of ten; the skin healed but the bone never closed

New Airplane View of Mount Wilson Observatory

FROM the vantage point of an airplane flying several hundred feet above the 5700-foot summit of Mount Wilson near Pasadena, California, one can obtain a clear impression of the famous Mount Wilson Observatory as a whole. The new photograph reproduced above was sent from Pasadena by one of the Corresponding Editors of this journal, Russell W. Porter, who is engaged in the cooperative project of the California Institute of Technology and Mount Wilson Observatory for building a 200-inch telescope and other equipment.

At the left is the long low structure of the Snow horizontal solar telescope. In front of its center is the 60-foot tower telescope, also for solar work, and near its end the higher powered 150-foot tower instrument for the same purpose. Nearer the reader and at the left edge of the picture the roof of a laboratory is partly visible through the trees. (The larger laboratory and the offices of the observatory are situated in the city of Pasadena). To the right is a reservoir and a comparatively small observatory dome which houses a six-inch refractor.

The two large domes are respectively those of the 60-inch and 100-inch reflecting telescopes. Between the large dome and the reader is the new Michelson-Pease 50-foot interferometer soon to be in operation. The entire housing for this refined instrument for measuring the diameter of the stars rolls off the instrument on a horizontal track.

"THE little cottage shown in the right foreground," to quote Mr. Porter's communication, "was built for the great astronomer Kapteyn, who occupied it for some time before his death. It is now used by the families of the observing staff and computers. Just out of the picture at the extreme left is the so-called Monastery where most of the astronomers live; also a hotel for visitors. The trees are pines, spruces, and live oaks; smaller growths are the manzanita and the yucca. Tame deer roam the observatory grounds unmolested. It is a hair-raising experience," Mr. Porter continues, "to come up the mountain by the narrow road in the big buses. If one car meets another the rule of the road requires that the one coming down must back up to a turnout.

"In the picture the distant mountains are typical of the San Gabriel Range. The long sloping line on the side of the mountain beyond Mount Wilson is a narrow road cut into the cliffs, and was designed primarily to permit the quick arrival of forest fire fighters. Somewhere near the distant horizon at the right, 30 miles away and 8000 feet up, an observer has 'dug in' for the winter. He is studying the 'air' and the 'seeing' at one possible future site for the great 200-inch reflecting telescope."

A New Departure in Bridge Building*

A Bridge of Unusual Design, Built by Unusual Methods, Is Nearing Completion Over the Elorn at Brest, France

By HERBERT E. STEINBERG, M.Inst.C.E.

QUITE a number of English engineers have already made pilgrimages to Brittany, with the object of inspecting the bridge over the Elorn River near Plougastel, which has been under construction for the last three years. Not only is it one of the largest reinforced concrete structures in the world, and designed for both railway and road traffic, but the methods of construction and the extraordinary number of ingenious devices used by the contractors are of absorbing interest.

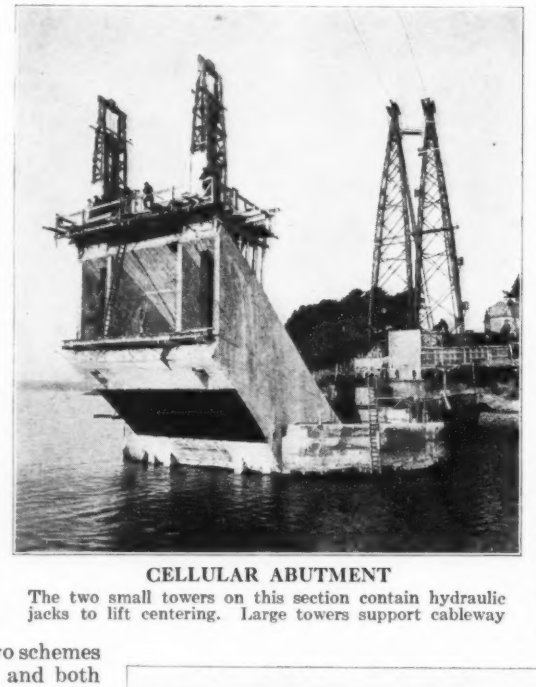
The river at the point selected for the bridge is about 2000 feet wide, with sloping banks on each side, rising fairly steeply to a height of about 120 feet above the water level. The rise and fall of the tide is very considerable, adding to the difficulties of construction.

THE bridge was the subject of a competition in design, and the conditions indicated that it had to be capable of carrying a single line of standard railway, as well as a roadway 30 feet wide, for vehicular traffic. A number of designs were submitted, and the three more practical schemes were examined in detail by the commission appointed to adjudicate. Two schemes were in reinforced concrete, and both were cheaper than the third which was a steel scheme. As each of the reinforced schemes was sponsored by responsible engineers, the cheaper of the two was selected for comparison with the steel scheme and, after close investigation, this design was adopted.

It consists of relatively short approach viaducts and three arched spans over the water, each span being 590 feet in the clear. There are consequently two river piers. The arches themselves consist of hollow reinforced concrete vaults having four longitudinal walls and top and bottom slabs. These arches are surmounted by cross walls, supporting longitudinal girders which carry the double deck construction for the railway and road traffic.

Reinforced arched bridges of this type are not unknown, and have already been constructed in spans nearly equal to the bridge now being described, a notable example being the bridge recently opened on the main road between Annecy and Geneva. The methods of construction used for the Plougastel bridge are, however, entirely original as well as being extremely economical and practical.

Several bays of the approach viaducts on each side were constructed in the ordinary manner, with climbing shuttering and timber trusses acting as centering for the reinforced concrete girders. Simultaneously with these viaducts, the river piers were built up to high-water level by means of a reinforced concrete caisson or diving bell weighing about 900 tons, working under compressed air, and surmounted by air-locks, which permitted either concrete to be deposited or spoil to be removed with very little loss of air. The piers were continued above water level, and the springings of the arches were also built, so that they cantilevered out several feet from the center line of the pier. These projecting pieces of the arches were used subsequently to support the centering, and to enable them to do this, their strength as cantilevers was temporarily increased by tying the portions of each side of the pier together with bars having their extremities buried in the concrete. The requisite amount of tension was developed in these bars by jacking them upwards and packing them in the desired position.



CELLULAR ABUTMENT

The two small towers on this section contain hydraulic jacks to lift centering. Large towers support cableway

IT was decided to use cableways spanning the full width of the river, in order to transport all material. The tenders for the cableway towers and necessary gear were, however, deemed unreasonably high, and M. Freyssinet, the designer of the bridge, therefore decided to design the necessary towers (which are 150 feet high) in timber. The timber, which is all in the form of joists and floor-board scantlings, is

BUILT ON LAND: THE CENTERING

The form which was to be the frame on which the concrete of the bridge was to be poured, was built on land. When finished, the supports were removed and the barges floated

*Reprinted by permission, from *Engineering*, London

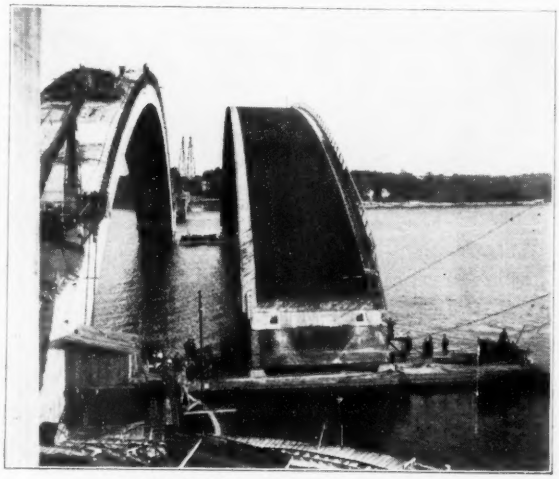
connected entirely by nails $^3/_{16}$-inch in diameter and 10 inches long. The ends of the tower have hinged supports formed by burying the timbers in the concrete, through which a hollow mandril has been placed, which forms the axis of the hinge. The towers were constructed horizontally and lifted into position by the cable, which was subsequently to be used for carrying the load. Smaller towers of similar construction were erected at convenient points, as sheer legs, in order to commence the lifting of the main towers. The back stays to the towers consist of a number of $^3/_8$-inch rods connected at top and bottom by means of concrete blocks, and anchored at their lower end to large blocks of concrete buried in the ground.

THE FIRST CONCRETE ARCH

The centering was floated into place between the abutments, lifted by means of the jacks in the small towers on the abutments, and fastened; then the concrete arch was poured

THE transporters are worked by electricity, the control cabins containing the motors moving backwards and forwards with the loads. The current reaches the motors through the overhead carrying cables, and returns through small hauling cables. Two similar transporters were built, and have worked without hitch for nearly three years, during which time they have handled many thousand tons of material.

The type and method of construction of the centering for the arches was the chief problem in connection with the bridge. It was finally decided to build a lattice arched centering in timber, which could be used successively for the three spans. To enable this to be done, two pontoons (each weighing 1000 tons) in reinforced concrete, were built, launched, and moved into position on the foreshore. Between them a number of timber towers were constructed, forming the ordinates to the parabolic curve of the centering, the towers near the middle being over 100 feet high. The lower ends of the arched centering, for a length of about 25 feet, were built in reinforced concrete, but the remainder was constructed in a manner similar to the towers for the transporters—that is to say, entirely in small section timber nailed together at the connections.



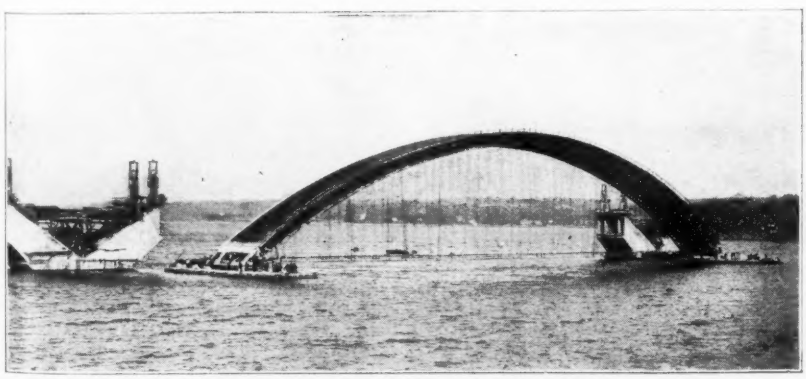
REMOVING THE CENTERING

After the concrete of the first arch was allowed to set, the centering was again lowered to the barges and floated away

Nearly 1000 cubic yards of timber were employed, and about 15 tons of nails. The curved top platform of the centering consists of 9-inch by 3-inch timbers placed on edge side by side, and nailed firmly together. These are surmounted by two layers of planking laid diagonally to act as wind bracing. The lower members consist of a series of ribs each made of four 9-inch by 3-inch joists nailed together and connected to the top boom by diagonal lattice work.

TO make possible the demolition of the temporary supporting towers, the ends of the arched centering were tied together by 80 wire ropes $^3/_4$-inch in diameter, and provision was made at each end for tightening or slackening these ropes by means of hydraulic jacks working horizontally. When the construction was finished, the temporary towers were demolished and the water pumped from the pontoons, which, in consequence, floated at the next tide and enabled the entire centering, having a span of nearly 600 feet and a height of 100 feet, to be floated out to its position between the piers of the first arch. This operation took only four hours; and the centering, which weighs 540 tons, was then jacked up and slung to the projecting portions of the arch already referred to. Slings were passed through the cantilevers and through the concrete ends of the centering.

In this condition the centering was, however, not strong enough to take the weight of the concrete, and provision was therefore made for converting it from a bow-string girder to a braced



INTO PLACE FOR THE SECOND ARCH

The centering is here shown, on its two concrete barges, being floated into position for the second arch. The horizontal cables give it additional strength to support the concrete

arch. This was done by taking the thrust through concrete blocks direct onto two projecting shelves left on the underside of the portions of the arch first constructed. This enabled the pontoons to be removed, and also permitted the tension cables to be slackened, the centering thus becoming a braced arch and capable of supporting the weight of the wet concrete.

The necessary stone for making the concrete was obtained by quarrying rock close to the site. Good sand was also obtainable locally, and the actual proportioning of the concrete was carefully controlled by test and experiment. A testing machine (in reinforced concrete) for crushing the tubes, was built on the site, and it was found that a small addition of stone dust increased the strength of the concrete. About 26,000 cubic yards of concrete were required.

WHEN the concreting of the arch was finished, the cross cables to the centering were again tightened; the concrete thrust blocks were cut away, and the centering gently lowered by jacks onto the pontoons, which had again been placed in position under each end. The entire structure was then floated out, and into position for the construction of the next arch.

This operation was done three times, but as the final demolition, either on shore or afloat, of such an enormous timber structure presented great difficulties, it was decided to make provision in the last arch for supporting the centering by bolts left projecting on the underside. This enabled the wire cables and the pontoons to be permanently dispensed with, and also permitted the timber centering to be cut, *in situ*, into pieces of convenient length, lowered into the water and floated ashore for demolition.

The greatest pains have been taken to eliminate stresses in the permanent work due to shrinkage and elastic settlement. The program for concreting the arch was carefully arranged towards this end, and not only was the concreting commenced and carried forward symmetrically from each side, in alternate lengths and gaps, but the portion of the bottom vault next to the springings was omitted—the thrust being temporarily taken by a series of pre-cast concrete struts. Similarly the portion of the four longitudinal walls next the springings was not done until the remainder of the arch was finished.

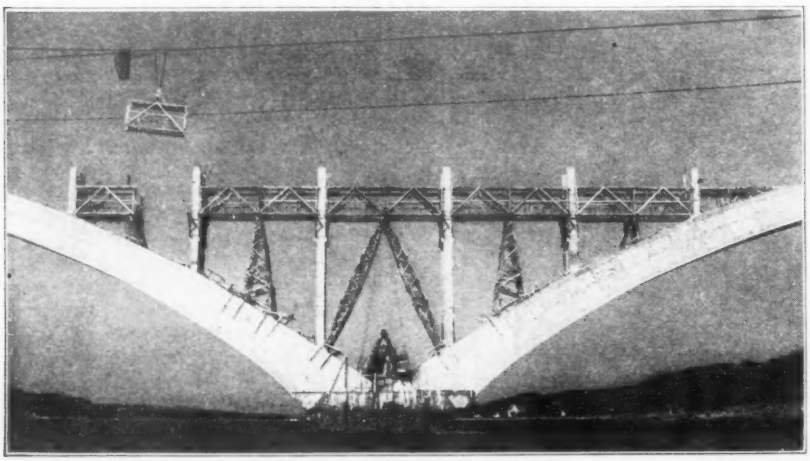
In addition to these precautions, niches were provided in the slabs and walls at the crown of each arch (where no reinforcement passed through) and a series of 28 hydraulic jacks, each with a capacity of 250 tons, were installed. These jacks were connected in series and operated by six pumps. They were expanded until the desired opening movement had been obtained, and the gaps were then grouted and the jacks removed ready for a similar operation in the next arch. Incidentally, the walls of the hollow vaults have been thickened slightly at the crown, in order to compensate for the loss of area due to the niches for the jacks.

THE ARCHES COMPLETED

The three arches having been completed, the centering is now useless. It may be seen, under the nearest arch, in process of demolition. In the background is the deck structure

At the present moment (October, 1929,) the three arches are complete and about two thirds of the timber centering have been removed. The remaining third is still slung from the underside of the arch. The sections of timber centering, after being floated ashore, are dismantled, a simple and practical form of nail-puller having been devised for quickly withdrawing the 10-inch nails.

The timber trusses forming the supports to the longitudinal beams carrying the railroad have been made ashore, and are now being carried out one by one and placed in position between the cross walls, and it is anticipated that another 12 months' work will complete the job. This process is illustrated at the bottom of this page. In the same view is shown the cableway conveyor, described elsewhere in this article, in operation.



THE SUPERSTRUCTURE IS BEGUN

Timber trusses being placed in position for the longitudinal deck beams. Overhead a completed form may be seen being lowered from the conveyor cable. Note thin walls

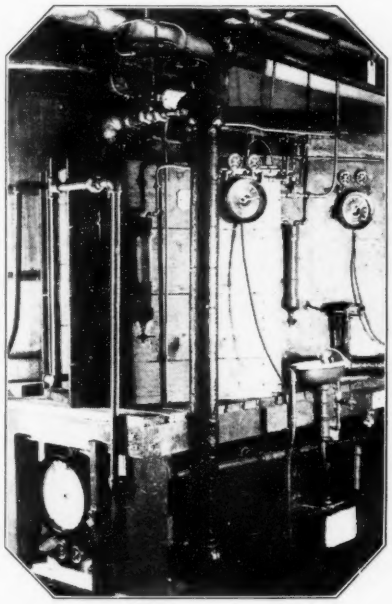
THE resulting structure will not only be a permanent example of the genius of M. Freyssinet, the designer of the bridge, but will also serve as an indication of the possibilities of reinforced concrete when both design and construction are in the hands of persons thoroughly conversant with this material. It is impossible in a short description to do justice, or even to mention the many original devices that have been developed and put to use during the construction of the work, but it is hoped that these notes, as the result of a recent visit, may be of interest. The contractors are Limousin and Company. The low anticipated cost of the bridge, coupled with the absence of maintenance charges, together with the artistic appearance of the final structure, should be of service in bringing home the paramount suitability of reinforced concrete for large bridge construction.

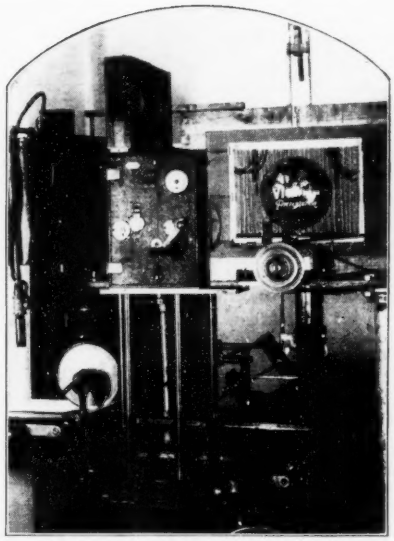
Movies Take On Color

By A. P. PECK

EVER since the invention of motion pictures, natural coloration in the films has been a goal toward which experimenters have worked with but little success until comparatively recently. All sorts of schemes have been tried, ranging from hand tinting of the individual frames to the simultaneous projection of two films, dyed in a separate color range.

The public, however, is critical of its entertainment, and crude efforts at natural color have been greeted with coolness and disfavor. Then the process of film coloration known as Technicolor was introduced, and as it was improved it found favor. Now comes Technicolor's only serious competitor, Photocolor, with a fully equipped plant for processing film and with a fully developed system for producing colored movies that faithfully reproduce on the screen the original subject.



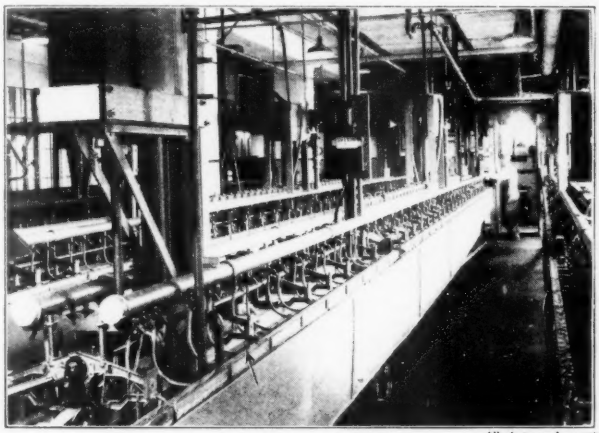


TITLING

In the foreground is the camera; in the background is the stand holding the copy

◄ TEMPERATURE CONTROL

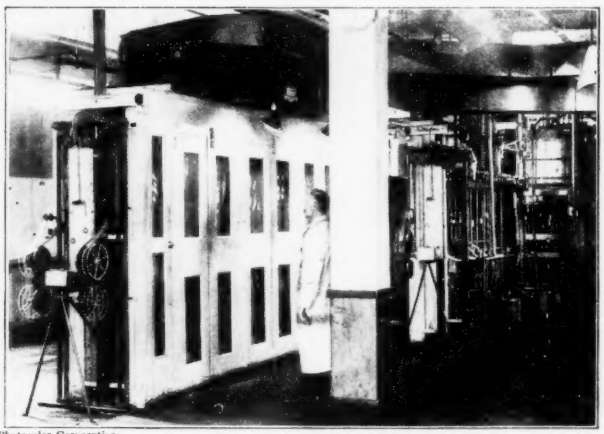
Absolute control of the temperature of the solutions is obtained by circulating water



GREEN-BLUE DYEING

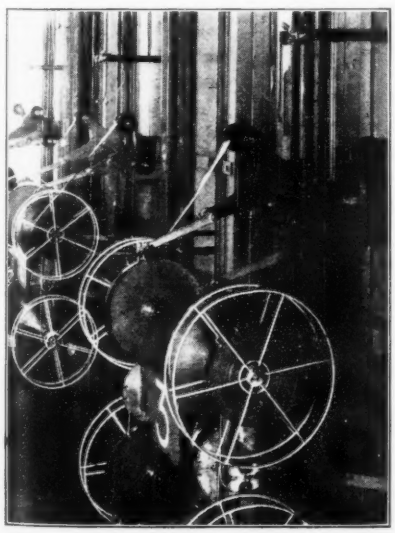
The film, indicated by the arrow, floats on a carefully regulated solution of dye, absorbing the color in the emulsion on one side

All photographs courtesy Photocolor Corporation



RED-YELLOW DYEING

After one emulsion is dyed, as at left, the film is run through the red-yellow bath, where the emulsion on the other side absorbs color



◄ TAKE-UP

After the dyeing operations, the film is dried and wound on these take-up reels

At a recent showing of a Photocolor production, the writer was favorably impressed with the degree of accuracy achieved in reproducing that bugbear of all color photography—flesh tints. Also, unusual in colored movies, pure blacks and clear whites furnished a pleasing contrast to the colors, all reproduced in the proper tones.

The Photocolor process has been under development for several years, during which time it has been refined to a point where a completely equipped plant is ready to start work on feature length productions. Essentially the system is as follows:

The camera is equipped with two lenses and operates the negative film at two and one half times normal speed. This is done because two frames of the film are exposed simultaneously, one through a filter for the red-yellow tones, and the other through a filter for the green-blue tones. There is a space between the frames that is eliminated in the printing. In the printing machine, which is accurate to within one ten-thousandth of an inch, alternate frames are printed on one side of a double-emulsion film, and the remaining negative frames on the other positive emulsion. Thus, the simultaneously exposed frames are registered and combined. When the positive is developed it is still in black and white. One side is dyed with a green-blue dye and the other with a red-yellow dye, the result being a close approximation of natural coloration when projected on a motion-picture screen.

MOTOR TRANSPORT SCHOOL

More than 1800 men in the motor transport school are registered for instruction. The course is very complete and experts furnished by manufacturers lecture. Principles and practice instruction run concurrently

Policemen Are Made, Not Born

In the Highly Organized New York Police College Every Branch of Law Enforcement Is Dealt With in Detail

By ALBERT A. HOPKINS

WHATEVER may be the causes of the organized crime of today—its bold robberies, dastardly disregard for human life, in brief, its apparent contempt for all the laws of society—the situation is critical. Our bulwark against the diabolical minority responsible for this state of affairs is the policeman, who often sacrifices his life so that "they shall not pass." From the humblest patrolman to the chief inspector, the ideas constantly borne in mind are the repressive influences as well as the actual detection of crime and apprehension of criminals. Every police officer is constantly on the alert, as he is part of the eyes and ears of the police department. But the policeman of today does not even remotely resemble the officer of the nineties. The great improvements which the 20th Century brought about are modern means of transport and communication, criminal identification, and police training.

We shall, at this time, concern ourselves with the latter question only. Police schools are not new, for there are 16 of them in the United States. For a long time, however, the Police Academy of New York has had the most elaborate organization of any police school and has recently taken a forward step by the creation of a "Police College" under the Presidency of the Hon. Grover A. Whalen, New York's versatile and efficient Police Commissioner. There are 11 schools in this college, so we could also refer to it as a "Police University."

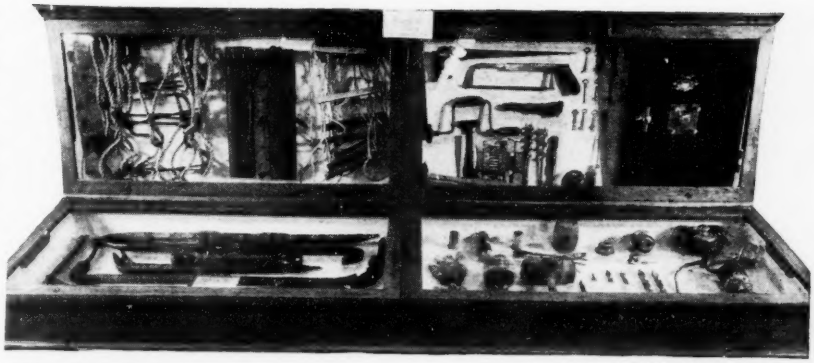
Police work is fascinating to the lay reader as is evidenced by the great popularity of detective stories which form a large slice of fictional literature.

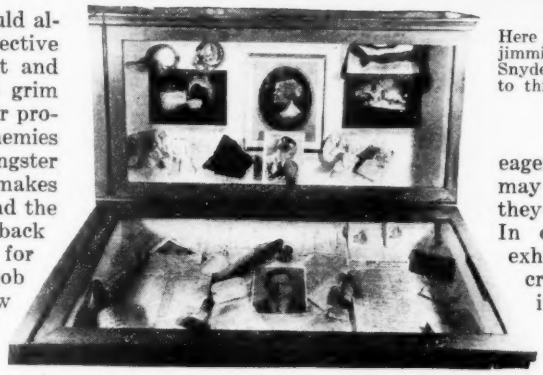
THE great mistake which most writers make is the creation of a super-detective who co-operates with the police and supplies the brains to Scotland Yard, or any other police headquarters. As a matter of fact, co-operation of this nature would be highly dangerous and has no basis in fact, for on the force are men picked to unravel mysteries and detect crime 365 days a year—the underworld never sleeps and takes no Sundays or holidays off. It is for the training of officers and men of the uniformed force, as well as detectives and "rookies," that the Police College was established.

Crime control must be approached from a scientific viewpoint as well as the practical one. Strong-arm methods are all right in their place, but strong-brain methods are equally important. The police must "outsmart" the criminal or society must suffer. Crime has become so scientific that we must devise improved methods of approach to problems which formerly did not exist. We hear a great deal of Paris, Vienna, Scotland Yard, and other great centers of police investigation, but we have, right in our own land, some of the most successful methods of detection that the world has ever known.

Near Police Headquarters there was an unused candy factory which was admirably adapted for a police school or college. It was rented for a period of five years at an annual rental of 65,000 dollars and was entirely remodeled to house the various schools, record rooms, engineering offices, et cetera. The seating capacity of the schools is 2100. There is an Advisory Board of nine members made up of prominent educators, law-school professors, and one of the assistant district attorneys. When we get down to cases, who is more competent to teach a policeman than a policeman? Superior officers should be the ones to teach the lessons which they themselves have learned by experience which is often bitter and costly. We can cut corners with well planned instruction by those whose personal experiences, both successes and failures, fit them to become teachers of police theory

and practice. Therefore 230 men, including a Chief Inspector and sergeants, have been assigned to the teaching force. Special lecturers include Justices of the Supreme Court, Judges of the Court of General Sessions, the United States Attorney, the dean of a law school, handwriting experts, prominent lawyers, surgeons, sanitarians, and criminologists. In fact, 11 pages of the program at the opening contained the names of exactly 500; certainly a large faculty, even though the majority wear blue uniforms and brass buttons.





A "BLACK MUSEUM"

Here are burglar's tools galore, rope ladders, jimmies, and all the evidence in the notorious Snyder-Gray case. The public is not invited to this Crime Museum, now or at any time

SUCH an array of talent would almost make writers of detective stories want to sit at their feet and learn at first hand some of the grim incidents that occur daily in their profession of combatting the arch enemies of society, particularly the gangster and the gunman. The faculty makes policemen out of raw recruits, and the "rookies" will in time come back for post-graduate instruction; for the patrolman's job is a job for young men. After a few years of hard-earned experience, all are able to compete for higher grades in the service and, if possessing ability, may rise to the position of inspector before retirement.

How can the Police College war against the gangster? It is a prime essential that a detective must have an excellent knowledge of the social foe with whom he is likely to deal. To this end, the most experienced men in the department acquaint the new detectives with gangster manners and customs. It would take years to gain the knowledge which these "hard-boiled" detectives impart in three months of intensive training.

THERE is nothing the gunman fears like the headquarters' camera, the lineup, and the fingerprint pad. A cardinal rule of the New York Police Department is that a gangster must be "frisked" on sight, as must his companions, male or female. The average gunman is not a two-fisted animal and without his gun he is lost; and if a gun is found on him the police know where he will be for the next five years. A gun is called a "rod" and a bomb a "pineapple" in New York gang-land. Gangs are constantly under the eyes of the police and are chivied hither and yon with relentless energy, so that sometimes the gangster goes to work from sheer exhaustion and becomes an unwilling member of the society which he has tried to undermine.

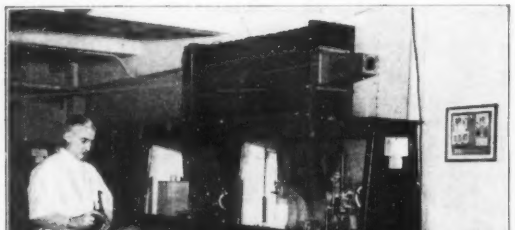
All crimes, however, are not committed by gangsters and the detective must be able to piece together the thin web of destiny from almost impossible beginnings: a piece of torn time-table, a half smoked cigarette, or a burned match stick may and has meant the "chair." On one of the floors of the Police College is a "black museum," like the one in Scotland Yard. The "public is not invited" but here will be found policemen and detectives eagerly scanning the exhibits which may mean a gold shield for them, if they answer the knock of opportunity. In one of the cases are over 100 exhibits showing how the "perfect crime" met its Waterloo. It was indeed thrilling to hear the man that pieced together the evidence in the Snyder-Gray case tell how a little scrap of a Pullman ticket led to the identification of Judd Gray, and spoiled a nearly successful alibi. Here are the burned match sticks which also helped to convict him. Here are the two bottles of poisoned whiskey carefully prepared for hubby by the loving Ruth. Here is a magazine with a colored cover and around it are figures showing that if she got the insurance she would have 78 dollars a week for life. Here is the torn Long Island timetable, the sash weight, the chloroform pad, the picture wire, and the necktie, all elements in this revolting crime for which two criminals were electrocuted.

"ROOKIES"

The disarming of criminals is one of the subjects taught and it is not elective either. The "rookies" become splendid athletes and are soon able to cope with brutes of the underworld

HERE are also collections of burglar's tools and jimmies of the 1929 model. It is a travesty on civilization that such ingenuity is spent on the production of such illegitimate tools for an illegitimate purpose when the place of their artificers is in the tool room of an automobile factory earning 15 dollars a day. The wages of sin are not very high; the average burglary nets $29.75—and a chance of a few years in prison.

The detective must have a very wide general knowledge if he is to rise in his profession. One of the principal objects of the college is to train newly appointed detectives to notice significant evidence when they see it. The familiar "*cherchez la femme*" is now changed to "find the bullet and the gun." Today when a criminal fires a shot, he seals his fate if the pistol is found. Fingerprints will identify the finger that pressed the trigger. The juryman hears the fire-



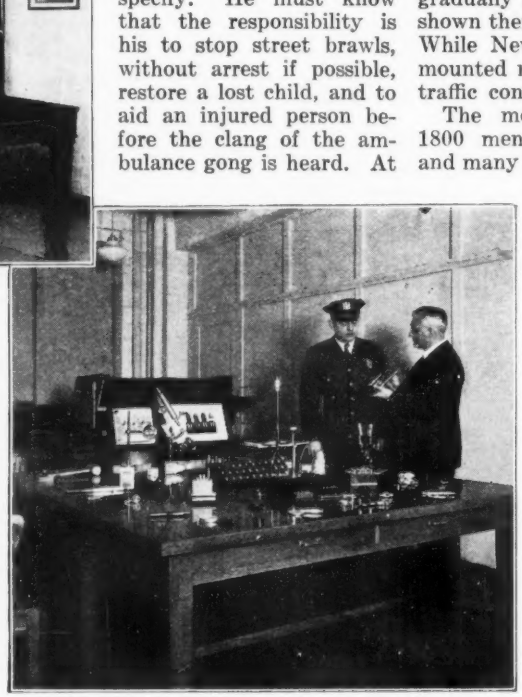
SMALL ARMS EXPERTS

The ballistics laboratory solves many crimes. Here we have Detective Stanley Gorman, small arms expert, and Deputy-Inspector John J. O'Connell, Dean of the Police College, in conference over a mysterious homicide case

arms expert; he gazes into the interior of the barrel; he sees photographic enlargements; he sees and handles the evidence. He learns that no two revolver bores are the same, and begins to realize that the policemen who collect such evidence are being given a scientific training which is very valuable. Ballistics, as taught to student policemen, enables the policeman to solve crimes with a certainty never before attained. By means of it, not only is guilt more clearly proved, but innocence absolutely confirmed. It is accuser and protector in one.

WHILE the College is intended to make "finer and broader minded" policemen, you must first have your policeman. Therefore, a large part of the building is devoted to the "rookie" who is qualifying for the line of blue or "getting on the force" as it is usually called. The candidates may come from all over the country but a year's prior residence in New York, just to get acquainted, is necessary. The applicant must be under 29 and weight not less than 140 pounds. He must pass rigid mental and physical examinations, and is then finger-printed to see if he is a wolf in sheep's clothing. He takes a pledge of office, is given a shield, and is ready for his 90-day intensive training. He is the ward of the city; and he soon sees that being a "cop" is a good deal more than a mere job.

The course in physical training is particularly severe, for the policeman cannot always use kind words. Only the ablest survive, and a close approximation to the perfect type is the goal. The student policeman's day is divided between calisthenics, wrestling, jiu-jitsu, and academic instruction in subjects germane to his future work. Such studies are the fundamental purposes of a police department and the part it plays in society. He studies the penal statutes, the courts, and methods of preparing evidence for the district attorney. The things he learns are too many to specify. He must know that the responsibility is his to stop street brawls, without arrest if possible, restore a lost child, and to aid an injured person before the clang of the ambulance gong is heard. At the end of the qualifying period, if the man has made the grade, he receives his badge of office; is allowed to buy a revolver and to go upon the street armed with authority which he must use with discretion. Present and prospective criminals will shun the company of policemen who are the product of modern training methods.



The special schools make the policeman a specialist. The mounted police constitute the "second arm of the service" and the horsemanship school instructs both the man and the horse; the latter must become used to revolver shots. Explosives and small fires are started near him and he is gradually led up close to the fire and shown there is no danger in it for him. While New York City has only 400 mounted men they are a great aid to traffic control.

The motor transport school has 1800 men registered for instruction and many of the large automobile concerns send engineers and instructors to lecture. The traffic school is very important; for New York, of all cities, being "long and narrow" needs the best traffic specialists that can be produced by education, and even policemen far removed from their rookie days must take an intensive course.

THE motorcycle school gives instructions not only to new men but to the 300 in the motorcycle division. The job is a depressing one, for a motorcycle officer hears enough sad stories to bring a sphinx to tears. All kinds of alibis are offered: one knows the Commissioner, another the traffic judge, still another tenders a "fiver." Despite all these lies, blandishments, and attempted bribery, the officer must do his duty, as he is held rigidly to account.

Grouped under the general head of the Bureau of Crime Prevention are those agencies having to do with all welfare work. The Women's Bureau of the Police Department has a force

THE OFFICE FORCE

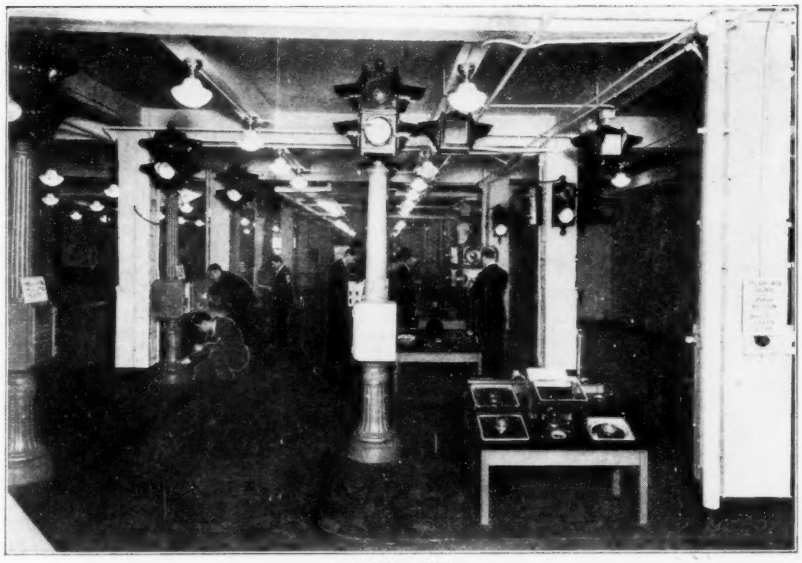
They may punch typewriters but they are all policemen, for police work is a man's job, except for the policewomen who have their own field looking after wayward girls, fortune tellers, and so forth. They also receive special instruction in the Police College

of more than 125 trained women. Their sole work is to protect women and children and to prevent the latter from passing over the line of safe home life to that of existence as wayward street waifs. Their main activities are the supervision of dance halls, the detection of shoplifters, the curbing of girl adventurers who are looking for the proverbial pot of gold, getting work for girls and helping them increase their earning power, and the detection and arrest of fortune tellers, fake and voodoo doctors, and moving picture "mashers." The Police College has a comprehensive course for police women. Preventive work is especially stressed in this department.

THE aviation school was deemed necessary, as modern police work demands that science play its part in the prevention and detection of crime in the air as elsewhere, and that every modern invention be utilized to further the ends of justice.

From more than 1000 candidates among the younger officers, only 12 were selected for this branch of the service. These men receive intensive training, both the Curtiss and Roosevelt fields being used as training bases. The air course in the Police College is thorough and complete. The New York Police Department is the first to have a regular patrolling air force, operating in much the same manner as the policeman patrols the streets.

From the policeman, we get the detective. The course of instruction in the School for Detectives aims to give the student ability to apply legal principles to concrete situations; to understand and appreciate people, normal and abnormal; to examine with a high degree of skill every detail connected with a crime; to spare no pains in searching for the slightest clue; to preserve exhibits and to consult experts; to make effective use of traces left by criminals; and to master the technique of criminal investigation in various fields according to their relative importance. This is a big job but the Police College is equipped to turn out an honest-to-goodness detective who could do more in shorter time than Sherlock Holmes. Here is where the well equipped laboratory comes into the picture, involving chemistry, microscopy, and ballistics.



"STOP-GO"

Policemen will be taught all about the traffic and lights on this floor. It looks like the electric show but nothing is for sale. The instruction is class work and demonstrations

There is also in the Police College a school of law to teach the basic principles of criminal jurisprudence, a training school for teachers, a training school for officers, a specialized training school (police emergency service and clerical instruction), and a school for pistol instruction.

We have covered the College rather hastily but there are also housed in the building certain police activities which are very important. There is a model muster room of a police station house, an exhibition of apparatus for the control of traffic, an auditorium, the property clerk's office, the record room, the traffic engineering department, and the printing bureau. In the printing department, manned by policemen, the confidential circulars, with "Wanted" as a scare head are printed.

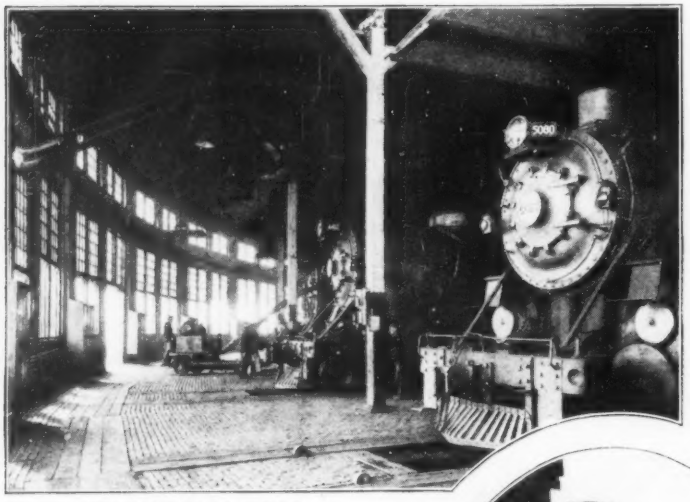
If a crook eludes the ring of detectives around New York City, he may ride on the very train which is carrying one or more of his pictures. In less than a week 250,000 police officers will know that he is wanted. The way of the transgressor is hard and is constantly being made harder.

The busy property clerk controls nine warehouses and is the largest second-hand automobile dealer in the world. Here are also many shelves filled with revolvers in brown paper envelopes and enough narcotics to supply every "hop-head" in gang-land for a year. He also has charge of more than 300,000 dollars in jewelry and cash. The record room can trace any of the 20,000,000 arrests made since 1855. Recently they had to look up the history of a woman criminal whose first crime was committed 65 years ago at the age of 15. The elapsed time of the search was less than a quarter of an hour.

THE PROPERTY CLERK

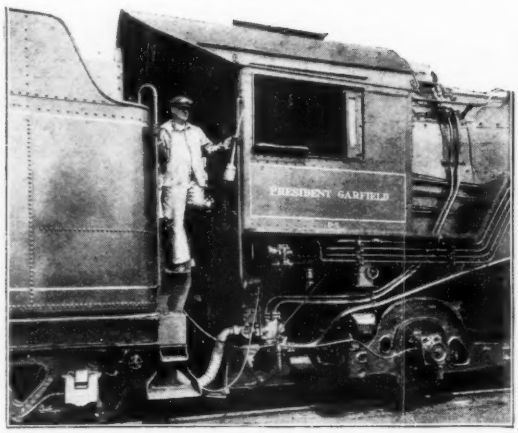
In the envelopes under the calendar are enough narcotics to supply all the "hop-heads" in gangdom for a long time. Every kind of article comes to the property clerk's office

THE foregoing gives one a feeling that the Police College will do much to aid clear, hard thinking by intelligent police officers so that they may do more to create fear of the law in the minds of criminals than all the jails and punishment cells of the last century. We are indebted to Deputy-Inspector John J. O'Connell, Dean of the Police College, for many courtesies in connection with the preparation of this article.



NO CORNERS HERE

Here the locomotive is sheltered, minor repairs made, and the firing-up process begins. The smoke passes out through a hood to the outer air. The semi-circular form of the round house was born of necessity, as the engine must be routed to tracks



END OF THE RUN

The engineer has brought the giant locomotive to the yard and is about to descend and make out his report. Great care is used to keep the 80,000 dollar machine in order. The locomotive will now be inspected by six experts and the ashes will be dumped

THE READY TRACK ▼

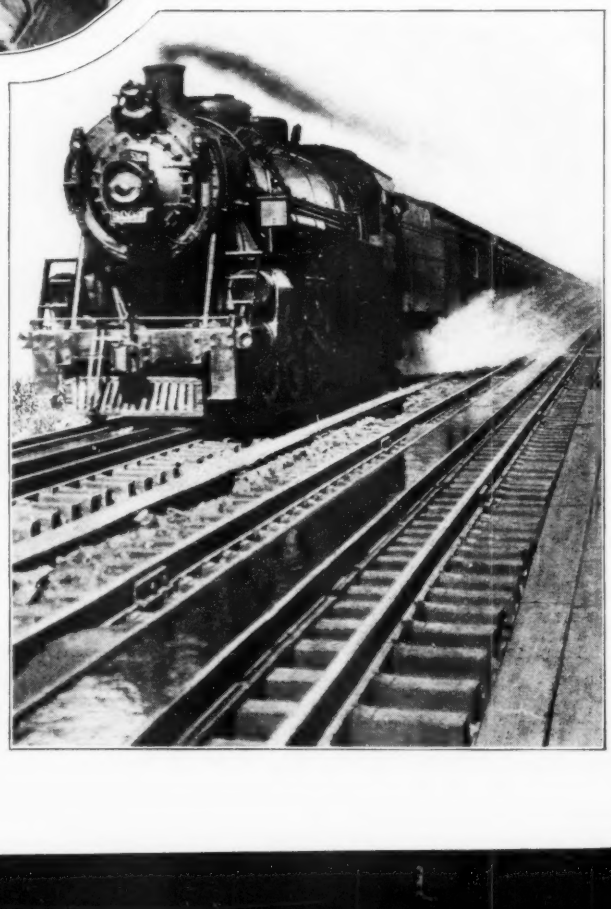
Here the locomotives stand with their crews awaiting the signal to start. They have been cleaned, fueled, watered, and sand put in the dome. They have steam up ready to do their part to help make dividends for the railway company

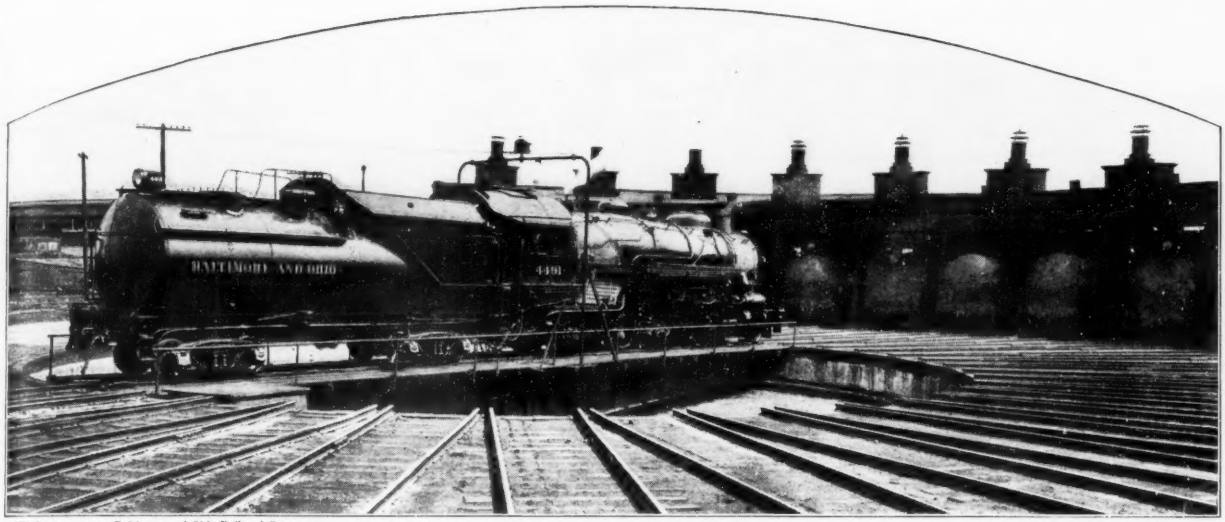
◄ "SAND"

Sand is almost as necessary as coal and water to assist in starting the immense load. The sand is thoroughly dried before it is put in the dome atop the boiler. The sand is blown on to the track as needed

"WATER" ►

Taking up water en route saves much time. When the track tank is reached, a scoop is let down and the water surges into the water tank on the tender. Track tanks are often a quarter of a mile long and are kept filled





All photos courtesy Baltimore and Ohio Railroad Company

THE TURNTABLE

The electrically operated turntable serves to berth the locomotives in the round house and gives them access to the proper track so that they may be refueled, obtain water and sand, and finally go to terminal or freight yard to be coupled to their burden of cars

'Round a Round House

When Its Hard Day's Work Is Finished, the "Iron Horse" Retires for a Bath and Complete Inspection

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice President, Baltimore and Ohio Railroad Company

ALTHOUGH we cannot truthfully say that a locomotive actually sleeps, it is true that a period of rest is beneficial. At the same time it allows a thorough cleaning and inspection of the machine before it again undertakes the responsibilities that accompany its long runs over the rails. Few of the inventions of man see harder service than the engines which haul our passenger trains on schedules that are seldom broken.

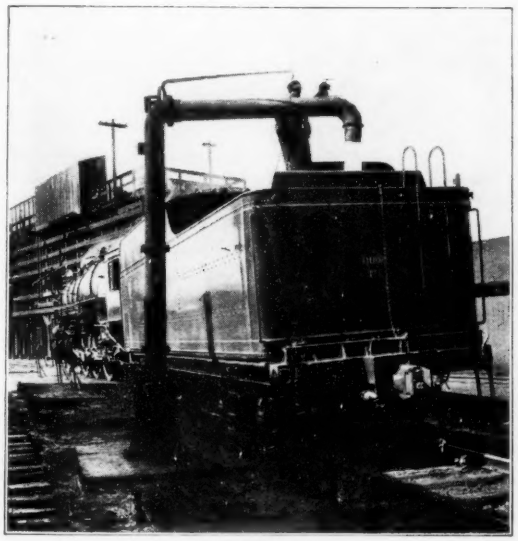
While locomotives are built nowadays on a progression system comparable to that of automobile mass production, still there is an individuality about them which is different from that of any other machine. Early in their careers they disclose variability as to steam distribution, acceleration, and tractive effort. All of these little quirks have to be straightened out, so that there may be uniformity in the locomotives as they stand fully fueled, with steam up, on the "ready track."

THE service period of a locomotive begins in its berth in the round house. Probably all have seen round houses, but few have visited them, for rather obvious reasons. A round house should be visited only when "personally conducted" by someone who knows the ins and outs of railroading, for there are many pitfalls in the railroad yards. A round house is a grooming shelter, circular in shape, where locomotives can be berthed for examination and firing up, and where minor repairs can be made. The shape of the building is such that the locomotives may be readily assigned to any designated berth, shifted to it with the aid of a turntable. The same turntable routes the locomotives to the tracks which lead to their daily tasks.

An elongated hood or "smoke jack" is located over each stall of the round house. This, in conjunction with electric motor-driven draft generators, permits the smoke and gases to be eliminated, so as to render the round house less murky than it would be otherwise.

The locomotives are fired-up with the aid of oil under air pressure. When the steam pressure is high enough to permit operation the engine is run out by the "hostler" on to the turntable, which is rotated so that the engine can be run, either to the ready track, if already supplied with fuel, or to the "coal tipple," where 8 to 12 tons of coal are run by gravity into the coal space of the tender. The coaling is accomplished with the aid of chutes and the amount of coal delivered is charged up against the locomotive and the run. While normally the locomotive backs beside the coal bridge to receive the fuel, means are provided at most terminals for coaling on any one of the mutiple tracks.

The water is supplied to the tank in the tender with the aid of a movable



"WATER"

10,000 gallons are poured into the tank. From Washington to New York about 25,000 gallons are used

"REPORTS"

The engineer makes out a report complete in all details at the end of every run

spout. This tank supplies water to the boiler under the direction of the fireman. The tanks hold from 10,000 to 18,000 gallons and a run from New York to Washington would require about 25,000 gallons of water and 11 tons of coal for the engines of the "President" class.

All is now in readiness for the crew, the sand boxes having been filled at time of taking coal. Sand is indispensable and is usually supplied at or adjacent to the coal-handling station. The sand, to be of any use, must be delivered to the sand dome of the locomotive in dry condition so that it will flow freely when needed. Special stove and steam sand driers are available. Varying with weather conditions, approximately two bushels of sand would be required for the trip mentioned. Sand is quite an item. A trunk line may readily pay 50,000 dollars a year for sand. The sand is used for starting, in order to give the driving wheels better adhesion to the rail. The sand is blown on the track with the aid of a compressed air jet controlled by the engineer in the cab.

The crew arrives and the engineer and fireman sign the book in the master mechanic's office. They look over their 80,000 dollar beauty to see if everything is "O.K." The dispatcher's orders must now be obeyed and the engine slowly moves to the head of the assigned train and the coupling is completed. The engineer and the conductor compare their watches. The leaving time approaches. The tower man gets a signal from the dispatcher's office. A lever clicks, a disk or semaphore changes position. The conductor signals the engineer, who sands the tracks, opens the cylinder cocks, and pulls the lever which controls the throttle valve concealed in the dome of the locomotive. The stately machine is in motion over the steel rails and we sit back in our comfortable seats while the begoggled and begloved crew on the pulsating locomotive watch for anything that looks like danger.

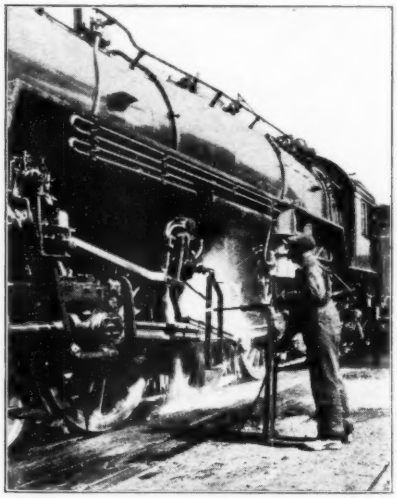
IN olden days the riding qualities of a locomotive were comparable to those of an artillery caisson. Today, however, this condition has been improved with such spring resiliency and uniformly distributed action of same that the riding comfort of the modern locomotive is almost equivalent to that of a Pullman car.

There is plenty for the crew to do until the end of the run is reached. Then the locomotive backs the empty train out into the yard. Here the engineer stops at the hostlers' quarters, delivers the locomotive to the shop forces, and gives an account of his stewardship in a written report.

What now becomes of the locomotive? An idle locomotive costs money, but a dirty locomotive is a liability and not an asset. In the early days the engineer and fireman did the cleaning, but as business increased and engines became larger, a group known as "wipers" was engaged to go over the machinery, jackets, and tanks, and finally six or eight men had to spend several hours to "wipe" a large locomotive. Now, however, a new plan has been introduced. This process, using what is known as the "locomotive wash rack," rapidly removes the accumulation of oil, dirt, and dust by means of a mixed stream of air, oil, and water, played at high pressure upon the parts to be cleaned.

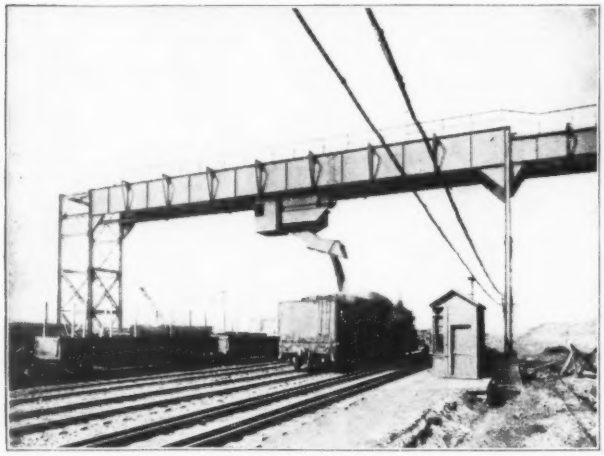
When the engine comes in from the run, the ashes are dumped at the cinder pit of the inbound tracks. It is then run on to the "locomotive wash rack." (See photograph below.)

Six men now inspect the locomotive and it is then ready to go to the round house for another preparatory period. At the scheduled or called time, it (we almost said "she," for that is the more affectionate term used by the railroad man), will be tuned up and fired, ready for the next long run.



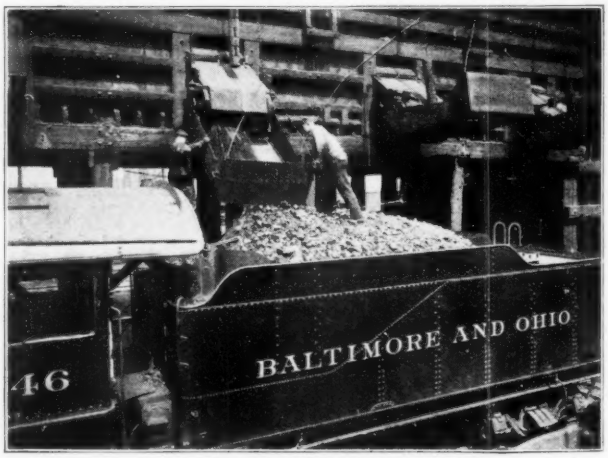
"WASHING"

Hot water, oil, and compressed air clean the engine, replacing a dozen "wipers"



"TRACK FUELING"

Here we have a tender being fueled on an intermediate track. This system tends to save much time in switching locomotives



FUEL BRIDGE

Coal is weighed out and dumped into the coal bin in the tender. The fireman controls the coal consumption by careful firing

Take Your Camera Into the Air

Whether on Your First Flight or on a Long Air Journey, You Can Make Snapshots With an Ordinary Camera

By ROBERT E. GOODE*

AERIAL flights have ceased to be a novelty. With increasing popularity and its attendant publicity, people now take to the air with the assurance of a safe return. With no time being devoted to the working up of an excellent case of nervousness, passengers are finding time to look around while up in a plane.

They are seeing sights from the air. The new angles of familiar objects appeal to them. Perhaps their photograph album at home has a dozen pictures of a show place—good snapshots, too, but none that can equal this "new" view. If on the ground, out would come the trusty camera to record the scene. Why not use the camera while in the air?

Many of us own a camera of some sort. All of us have, at some time or another, taken a snapshot that we secretly thought was just about as good as any professional photograph we had ever seen. That automatically qualifies each and every one of us as an amateur photographer. But in spite of our general knowledge of cameras, most of us are inclined to think of aerial photography as an extremely professional calling. This is not so.

AGAIN, we are likely to believe that special equipment is necessary to obtain beautiful aerial photographs such as are shown in the Sunday rotogravure sections. Neither is this so. The person who takes only a short sightseeing flight should carry his camera along and the person who commutes back and forth in one of the huge airliners should certainly take advantage of his many opportunities to obtain good snapshots.

*See "Among Our Contributors," page 261

YOUR OWN BACKYARD

As the plane in which you are flying casts its shadow over your home, make a snap

The old familiar box camera will take pictures from the air as well as on the ground. The Graflex works as well at altitudes as at sea level. It, of course, takes a photograph proportionately better than the family box camera. Familiarity with rapid rectilinear or so-called double lenses of f.8 or U. S. 4 diaphragm opening is a great advantage.

Various kinds of ordinary cameras were used by the author in gathering illustrations for this article and a large number of other splendid ones. So you see, any type will operate in the air successfully. Good pictures can be obtained with ordinary roll film and film packs. Clouds and ground haze, however, often complicate the case. A general knowledge of color-sensitive films is helpful. The use of color filters is simple and useful.

A scarcely perceptible haze may ruin an otherwise good picture. Haze possesses a bluish tint that photographs as white. A snapshot taken under these conditions will appear to have been taken through a gauze screen. Fortunately, haze is the only color problem that the amateur need worry about. The resulting cloudy effect can be eliminated by using an orthochromatic or panchromatic film. A yellow color filter should be used in conjunction with these films. Commercial orthochromatic film in either rolls or cut-film form is recommended. Most aerial pictures made by professionals are on this type of film.

BY AMATEURS' METHODS, BUT GOOD

Mission Beach, San Diego, California, photographed on panchromatic film, using a "minus blue" filter. Note how the filter has made the shoals show up in the water off the beach

PRACTICALLY all of the novice aerial photographers will take their pictures from a large cabin airliner. This is best since a howling wind is not present to interfere with the operations. Moreover, there is more room in which to move about.

It is perfectly feasible, however, to take photographs from an open cockpit type of plane, and in some cases, it may be better. For example, in photographing another plane in the air, the upward and downward angles may give better results. Such shots would be very difficult in a cabin plane. The sketches in Plate I illustrate the angles through which photography is possible in an open cockpit plane.

The folding camera must be protected from the slip stream, otherwise the bellows will blow inward and cut off a portion of the resulting photograph. Moreover, the turbulent air will cause vibrations and resultant blurring. It might even blow the bellows off the camera. The camera may be shielded behind the windshield or behind the body. The pilot is

YOU CAN DO AS WELL

This splendid view of a section of Coronado, California, was made with ordinary roll film and no filter was used. With your own camera you can make many such pictures for your album

always willing to throttle down his engine to idling speed if you make your wants known. This will reduce the passing windstream, and will also decrease the vibration of the plane.

By all means always hold the camera with your hands. In this way, the body will absorb most of the natural vibrations of the plane. If you rest your camera on the fuselage of the plane while "shooting," the photograph will be blurred and unsatisfactory. To eliminate blurred pictures further, combine a very short exposure with as small a stop as possible. The exposure should not be longer than 1/100 of a second duration in open cockpit planes.

Plate II shows the positions in which a folding camera should be held for best results. If used as in Figure 2, the viewfinder will show the view in an inverted position as in Plate III.

The box camera, of course, is not adjustable. It is necessary merely to aim it and make your exposure. Remarkable results have been obtained with this type of camera.

THE best altitude for photographs is from 1200 to 3000 feet. If under 1200 feet, the relative motion between the plane and the ground is too apparent and close objects will be blurred. If over 3000 feet, the distance is excessive except for cameras made especially for that purpose.

Operation of the Graflex type is, in general, the same as for a folding camera. In this case, however, the focusing hood will give trouble because of its tendency to blow off. It is advisable to focus your camera while you are on the ground. Mark a scale on the focusing rack to be used while in the air. This will eliminate the necessity of using the hood while in a plane.

Another method of avoiding difficulty with the hood is to re-inforce it with plywood or some light, strong material. Or, you may even replace it with a similar box of plywood or sheet metal. The advantage of these methods is that you can have a perfect focus because the ground glass can be seen at all times.

Focusing is unnecessary when using aerial cameras. Their operation is simple in every way. A direct-view sight is provided in order that sighting can be done from the level of the eye. Some of these cameras require the operator to re-wind the shutters and then to change the film. In others, this operation is combined. No lens stops are provided with aerial cameras but they can be easily made from black paper or from tin, painted black. These pieces are inserted between the elements *of the lens.*

No matter what the type of camera used in the open cockpit plane, take no chances on losing it. Make fast a strong cord on the camera and tie it securely to your body, or to the plane. If it should be blown from your hands, you can at least retrieve it.

The length of exposure is governed by a great number of variables. Among these are altitude, strength of light, conditions of atmosphere, and kinds of filter used.

A "between the lens" type of shutter is used on the ordinary camera. These shutters usually are graduated in 1/100th, 1/50th, and 1/25th of a second—speeds that are adequate for most aerial photography. High shutter speeds are desirable to obtain good results consistently for they help to eliminate blurring caused by vibration and to stop motion at low altitudes.

WHEN vibration and wind can be avoided, as in a cabin plane, 1/25th of a second may be used when at an altitude above 1000 feet. Cameras of the more expensive type have shutter speeds up to 1/1000th of a second. Some foreign types are capable of even shorter exposures.

Eposures may be computed with an exposure meter. In your calculations bear in mind that all views from the air are of distant objects. The most accurate method known is to use a "Justophot Exposure Meter." This is a vision meter which is easily operated by sighting at the object which is to be photographed. The correct exposure is then read directly off a scale.

When photographing through a haze, color filters can be used to advantage. This is also true when a background such as fields appears excessively green or yellow. The use of filters will accentuate detail in these colors.

Light yellow filters do little other than penetrate haze, although they correct slightly for the various densities

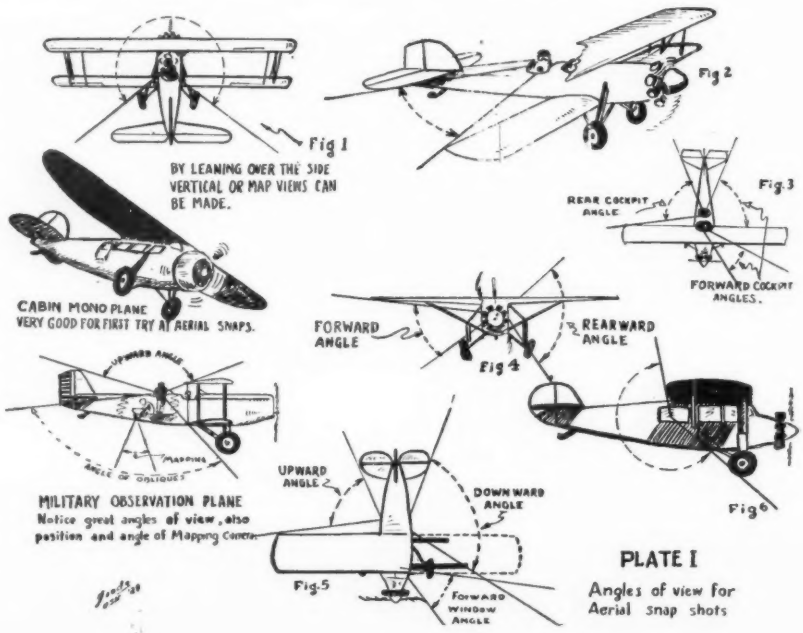


Fig 1
BY LEANING OVER THE SIDE VERTICAL OR MAP VIEWS CAN BE MADE.
Fig 2
Fig 3
REAR COCKPIT ANGLE
FORWARD COCKPIT ANGLES.
CABIN MONO PLANE VERY GOOD FOR FIRST TRY AT AERIAL SNAPS.
FORWARD ANGLE
REARWARD ANGLE
Fig 4
Fig 6
UPWARD ANGLE
DOWN WARD ANGLE
MILITARY OBSERVATION PLANE
Notice great angles of view, also position and angle of Mapping Camera
Fig 5
FORWARD WINDOW ANGLE

PLATE I

Angles of view for Aerial snap shots

of color. Dark yellow filters fully correct for the apparent density of color. Extremely dark yellow and orange filters are used to emphasize some detail of the landscape. For example, a beach will appear very light while the water will appear quite dark. Often roads are made to stand out clearly from the surrounding country by this manner of over-correcting. Haze can be eliminated by combining these filters with a panchromatic film and a fast lens.

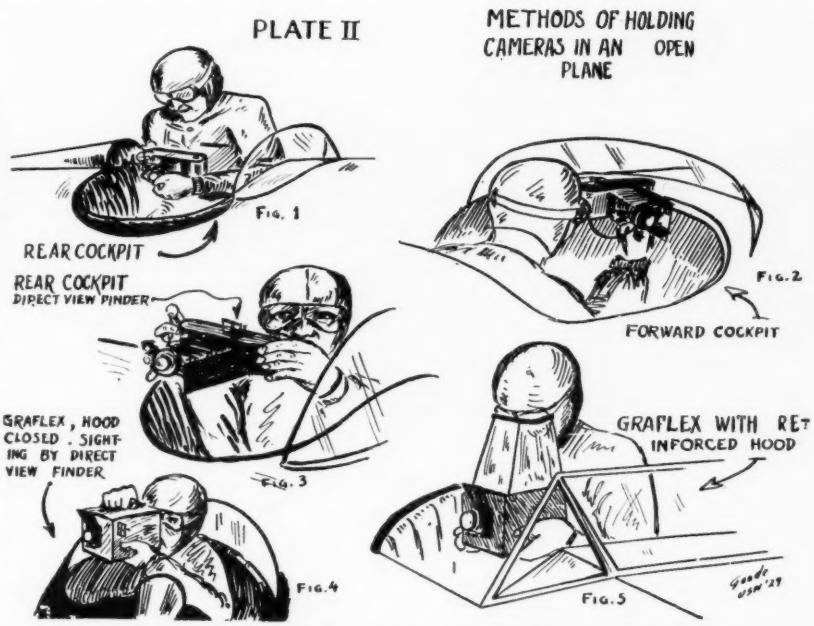
OVER-EMPHASIS is also gained by the use of a red filter. In the resulting photograph, red appears lighter than yellow. Blue shows up as black. Slight variations of green are very noticeable. This property of a red filter was used to advantage during the World War. The green paint and artificial trees of camouflaged objects showed up clearly against the natural foliage. Browns were easily detected when the fresh foliage had dried up. Camouflage fooled the eyes but not the cameras. This partially explains why so much importance was attached to aerial photography during the war. The use of a Wratten K1 filter requires approximately five times longer exposure than when using roll film without a filter.

It is advisable for the beginner to use the gelatin film form of filters for economy's sake. They can be cut to any necessary size to fit between the lenses of the camera. Care must be

LOOKING INTO THE FINDER

Scene will show upside down in finder when camera is held as in Figure 2, Plate II

taken in order to prevent moisture being transferred to the filter by the hands. It is best to cut the filter to size and form before removing the wrapper. This prevents unnecessary handling. Remove the wrapper as the filter is inserted between the lenses. Scratches on your filters should be prevented by handling them carefully by the edge.



CAMERAS THAT MAY BE USED, AND METHODS OF HOLDING

Orthochromatic film in cut-film form is more sensitive to yellow and green rays than the ordinary roll film. Consequently, when using a filter with this film the increased exposure need not be so great. Generally, the orthochromatic roll film is not so sensitive as the cut film or plate. An exception to this is the Wellington Anti-Screen film. This has a filter manufactured into the film and thus obviates the necessity of any additional filter except under unusually hazy conditions.

PANCHROMATIC films are most sensitive to all colors. They are readily obtainable in either cut-film or plate form. Rolls are provided for the largest aerial cameras. This type of film gives especially clear results if brown predominates the landscape. Because of its sensitiveness to all colors this film is most easily adaptable for over-emphasizing by the use of filters.

Great care must be taken in developing. The red safelights ordinarily used by photo finishers in their developing rooms are as destructive to panchromatic film as daylight. Total darkness is desirable, though a Wratten, series three, green safe-light may be used. If the amateur does not develop his own work, he should patronize a well-recognized commercial studio. Explain carefully just what kind of film you have.

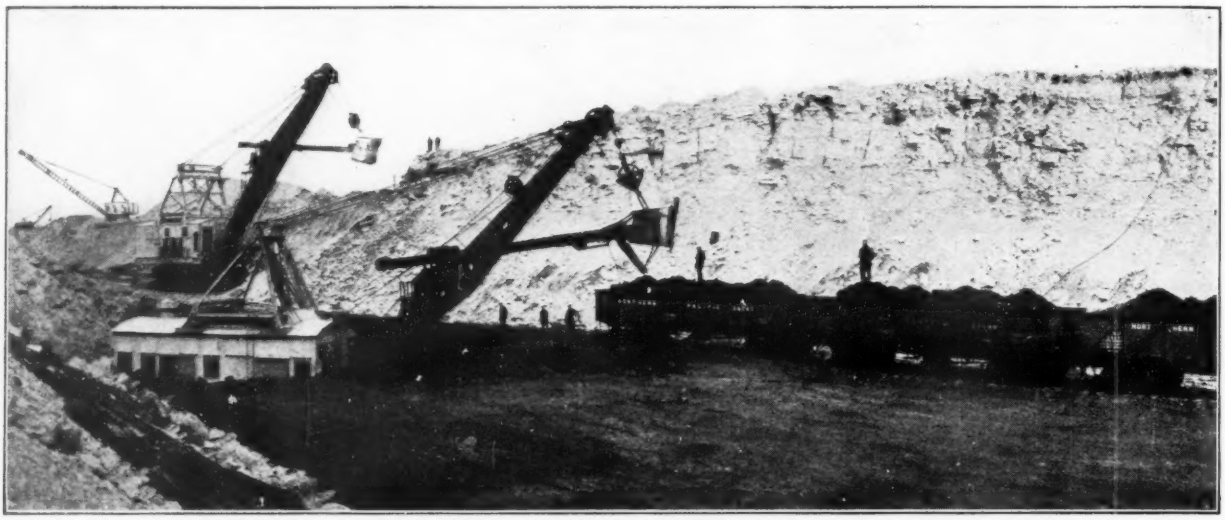
The small motion picture camera which has become so popular is capable of taking excellent pictures from the air. Good results can be obtained with ordinary film and the f.22 stop. Proportionately better results will be had with a panchromatic film and a K1 or K2 Wratten filter. The filter demands a longer exposure, of course. With the K1 filter, use f.16 stop while an f.12.5 stop may be used with the K2.

The motion picture cameras are handled similarly to the still cameras. Avoid vibration and wind blasts. A lens of focal length longer than 2 inches or 50 millimeters will lead to blurring of the resulting picture.

The first attempt at aerial photography may be discouraging. A little practice, however, will give results that are well worth the time and effort spent. More and more people are using aerial transportation. A great many of these passengers carry their cameras tucked away in their luggage. Why not use them en route? Parts of this discussion may seem too complicated to people who have always used their cameras simply to make unstudied pictures—snapshots on the spur of the moment. If you belong to this class, ignore the discussion of filters for the time being, make your snaps according to your usual methods, and you will be pleasantly surprised with the results. As time passes, you will gain by experience and may wish to improve your pictures by the use of filters. In any case remember that:

Working rules for amateur aerial photography may be concisely summed up as follows: 1.—Use as short an exposure as possible; 2.—Exposures in the air are approximately one third of those on the ground; 3.—Hold the camera in your hands and out of the wind to avoid blurring.

¶ *"When you buy your plane" is the subject of a comprehensive discussion coming in May. This article will tell you the things you ought to know if you are in the market for a plane for private flying. Read it and be prepared.*



STRIPPING OPERATIONS AT THE WORLD'S GREATEST OPEN-PIT COAL MINE

Scooping up eight tons of coal, the new electric loader dumps it in the waiting freight cars. The stripper follows, widening the cut and dumping the overburden in the channel behind the loading shovel. In the distance is shown a drag-line excavator with a 150-foot boom

Mining Coal With Mammoth Shovels

Open-Pit Mining Operations at Colstrip, Montana, Using New Operating Equipment of Unsurpassed Size and Efficiency

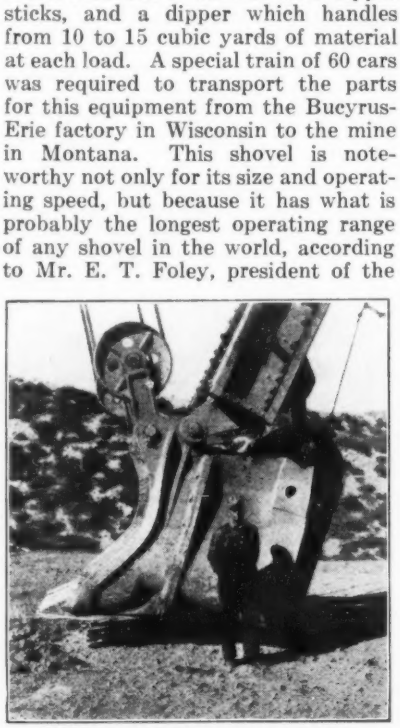
By HENRY W. HOUGH

ON-THE-SURFACE mining long has been recognized as the ideal method of extracting various minerals from the earth. Two noteworthy examples of such operations are the bench workings of the copper mines at Bingham, Utah, and the famous open-pit iron mines of the Messaba range in northern Minnesota.

Of the numerous coal "stripping" operations, perhaps the most interesting are those conducted by Foley Brothers, Inc., on the Northern Pacific Railway Company properties at Colstrip, Montana. At this mine, new operating equipment of the most advanced type recently has been installed. Colstrip is situated about 80 miles northeast of Billings in eastern Montana—part of the Great Plains.

MAN'S domination of the earth is appreciated when one witnesses the gargantuan work of a new electrically-driven machine, operated by one man, which bites a hole in the ground large enough to serve as the cellar for a house, and deposits the 15 tons of excavated earth a full city block away, perhaps at a height equivalent to that of a 10-story building. Within one minute the operation is completed, and the shovel is back for another 15-ton bite.

This machine, which recently has been placed in operation at Colstrip, is a newly designed Bucyrus-Erie stripping shovel. It weighs 1100 tons, has a 120-foot boom with 90-foot dipper sticks, and a dipper which handles from 10 to 15 cubic yards of material at each load. A special train of 60 cars was required to transport the parts for this equipment from the Bucyrus-Erie factory in Wisconsin to the mine in Montana. This shovel is noteworthy not only for its size and operating speed, but because it has what is probably the longest operating range of any shovel in the world, according to Mr. E. T. Foley, president of the contracting firm which has charge of the Colstrip operations.



THE NEW STRIPPER'S DIPPER

Each time this new shovel bites into the earth, it removes 15 cubic yards of dirt

The stripping machinery was assembled in a new pit which will be two miles long and about 900 feet wide. This pit, which will be slightly longer than that in which operations were begun in 1923, contains more than 11,000,000 tons of coal. The deposit or vein of coal is from 22 to 28 feet in depth, which is several times the thickness of most veins which can be exploited economically.

A WORTHY team-mate of the stripping shovel described above is the new Bucyrus-Erie coal loading shovel, another recent installation. This machine lifts out more than eight tons of coal in one operation, raises its load to an unusual height, and dumps the coal directly into gondola cars standing on temporary railway tracks skirting the pit. This operation, as timed by a stop-watch, requires only 45 seconds. In a 10-hour shift this machine will dig and load 5000 tons of coal.

The combined capacity of this loader and a slightly smaller one which has been in use at Colstrip for some time, is 20,000 tons in 24 hours. This much coal would fill 400 average freight cars, or about 300 of the new 70-ton cars recently purchased by the Northern Pacific. The new shovel is probably by far the largest coal load-

ing shovel in the world, according to Mr. Foley. It is operated by an electric motor-generator set, as are all of the other large machines at Colstrip. The Montana Power Company supplies the electricity from its interconnected hydro-electric plants located in various parts of the state.

Other major items of the operating equipment now in use include a Marion drag-line excavator with a 150-foot boom and a six-cubic-yard bucket, a Marion stripping shovel with a rated capacity of eight cubic yards, two General Electric 72-ton storage battery locomotives, and a new General Electric-Ingersoll Rand Diesel-electric locomotive. All of this equipment is used in the pits, with the exception of the drag line, which is used in the initial work of removing the overburden. All of these enormous shovels, including the drag line, move from one scene of operations to another under their own power, crawling on huge caterpillar-type wheels.

BLACK blasting powder is used to loosen the overburden, a layer of sandy earth about 40 feet in depth. This common explosive, probably the oldest known to man, has been used for thousands of miles of railway and highway construction, and is considered "an old stand-by" in the mining industry. Liquid oxygen is becoming popular as an explosive for shooting overburden, but has not been used at Colstrip, to the writer's knowledge. After the layer of earth has been loosened, the drag-line excavator removes the dirt, piling it some distance away in a mountainous dump paralleling the pit or channel. About one and one half cubic yards of overburden are removed for each ton of coal, an uncommonly economical proportion.

Railroad tracks are laid on top of the layer of coal, at one side of the cut. The coal to be removed is loosened blasting, and the loader in the pit scoops it up, raises it to the required height, and dumps the coal in the cars. Following the coal loader comes the stripper, widening the cut. As the overburden is removed, the stripper drops the dirt into the channel behind the loader. The dirt deposited in the cut takes up much more room than the coal did, so as the process continues, the landscape assumes the appearance of a series of miniature mountain chains placed side by side. From an esthetic point of view, the appearance of the landscape is not enhanced by stripping operations, but the workings present an interesting picture, particularly from an airplane.

Government geologists inform us that the Colstrip operations are being carried on in the Rosebud coal bed of the Tongue River member of the Fort Union formation. The Forsyth coal field, on which the Colstrip property is located, contains approximately 20,000,000,000 tons of coal and extends beneath a region about 800 square miles in area. This field is a section of the great coal bed underlying an enormous region in Montana, Wyoming, and the Dakotas. A strip mine in Wyoming, in another section of this remarkable deposit, is operating in a coal bed 79 feet thick.

THE coal mined in the Forsyth field is sub-bituminous, with heating value about 80 percent of coal produced in the deep mines at Red Lodge, Bearcreek, Bridger, Roundup, Sheridan, Sand Coulee, and other mining centers of the region. Representative analyses show the coal from the Rosebud bed (Colstrip) to contain from 9090 to 13,230 British thermal units. It is shiny black on a freshly exposed surface, but has a marked tendency to slack upon short exposure to weather, a weakness rather common to coals of the region.

READY TO MOVE A MOUNTAIN

This electric stripping shovel can dump its load at the height of a 10-story building, 300 feet away

Coal always has played an important role in the development of frontier regions. This was particularly true in the northwest. When the surveyors were gathering data required by the Northern Pacific for constructing the first of the northern transcontinental railroads, their reports showed that the new road was to traverse one of the greatest coal bearing regions ever known. Pioneer settlers made it a practice to obtain their winter's supply of coal from the thick beds of the region simply by blasting it off the face of one of the numerous out-crops. The only easier method was to set fire to the out-crop, which was not an uncommon practice. However, such methods had their limitations.

NOT many years after the railroad opened up the country for settlement and development, dozens of coal mining towns had sprung into existence. At first they were kept busy supplying fuel to meet the railroad's needs, but later the industry expanded to meet the industrial and domestic requirements of the rapidly developing region. As the miners dug deeper and deeper and production became increasingly expensive, strange, disquieting

THE NEW STRIPPING SHOVEL IN OPERATION

Unusual size, exceptional operating speed, and unsurpassed operating range distinguish this one-man electric shovel. Note the relative size of the man on the dipper handle

THE COLSTRIP WORKINGS FROM THE AIR

Viewed from an airplane, the workings at Colstrip resemble a series of mountain ridges side by side

rumors began to reach the mining towns. It was said that a new mining property of fabulous character was to be developed by the Nothern Pacific, which had acquired from the government most of the valuable coal lands of the region.

According to these rumors, a great coal vein 25 to 30 feet thick had been located near Forsyth and was to be developed; the coal was so near the surface that it could be dug out by "steam shovels" and loaded directly into freight cars! To most of the miners it sounded like a myth. But industry demands ever-increasing efficiency. It is not enough to equal the production achieved last year by a given number of workers at the same cost. It is required that fewer men working under more favorable conditions shall produce more goods at less cost. Such an inexorable demand can be met in only one way — by creating and utilizing new and improved power-driven machinery to exploit the enormous deposits of low-grade coal. The myth become a reality—daybreak at Colstrip meant twilight at the deep mines.

ROSEBUD County, in which the Colstrip mine is located, now leads the rest of Montana in coal production. Fewer men were employed in the coal mines of the state last year, but the records show increased production and an increased output per man, at a reduced cost per ton.

Two or three men operating the new electrically-driven coal loading shovel described above can dig and load more coal in a shift than can dozens of workers in the average deep mine. Each worker in the pit averages 50 tons of coal a day, or about 10 times the normal unit production of coal mines. Not more than 75 men will be needed at the Colstrip mine to produce the 11,000,000 tons recently contracted for by the Northern Pacific. This amount of coal will be sufficient to meet the company's requirements for this class of fuel for the next eight years, according to present estimates.

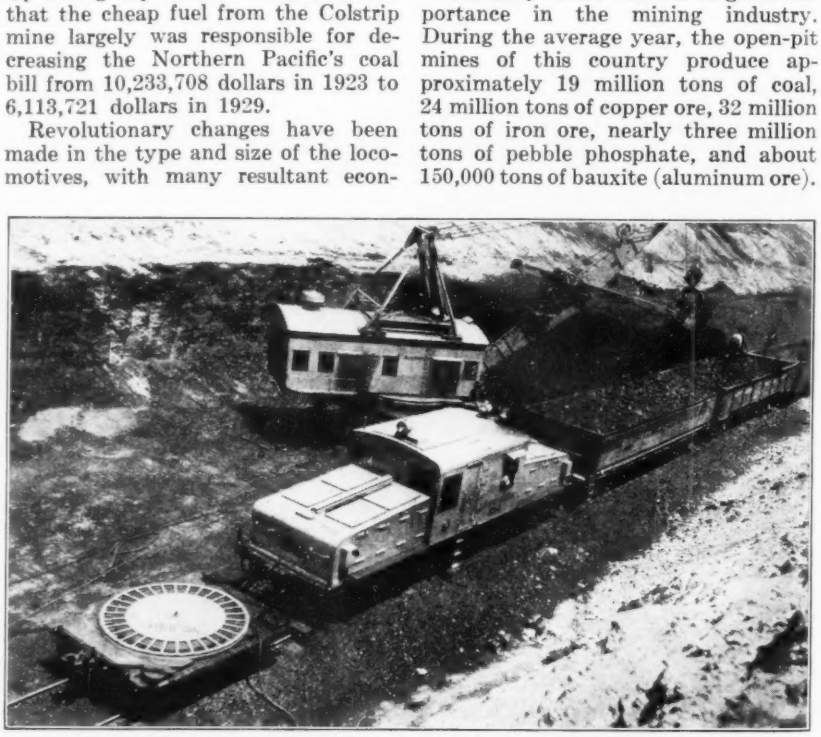
Far-reaching economy has accrued to the railway company through the opening of the Colstrip mine, under its contract with Foley Brothers. Shortly after the government returned the railways to their owners, an economical method was developed for obtaining coal from the Colstrip mine. Then, vigorously commanding its engineering talent, the railway company devised a thoroughly practical method of burning the lower grade coal in its steam locomotives. This proved to be a mechanical problem, involving reconstruction of the locomotive fire boxes.

Today this semi-bituminous coal is being used on all Northern Pacific freight and passenger locomotives operating between Spokane, Washington, and Jamestown, North Dakota. Operating department officials declare that the cheap fuel from the Colstrip mine largely was responsible for decreasing the Northern Pacific's coal bill from 10,233,708 dollars in 1923 to 6,113,721 dollars in 1929.

Revolutionary changes have been made in the type and size of the locomotives, with many resultant economies. Locomotives have been made to haul trains longer distances, and the power of each engine has been increased greatly. In 1922 the company owned 1441 engines with an average power or tractive effort of 38,143 pounds. Between 1922 and 1929 many uncommonly large locomotives were purchased, making it possible to displace and dismantle a large number of the smaller engines. Within this period, the number of locomotives owned by the company was reduced from 1441 to 1099. The average power of each engine was increased to 41,244 pounds.

AS a direct result of using Colstrip coal, the company recently purchased the largest steam locomotive in the world. Its enormous proportions are due to an advanced mechanical design permitting the use of lower grade coal. This locomotive is 125 feet in length, and is of the Mallet type, used in mountainous districts. An order for 11 more of these large Mallets has been placed, and when they are received 28 more engines of ordinary size will be displaced and dismantled. The average power (tractive effort) of the locomotives owned by the Northern Pacific then will be 42,870 pounds.

For many centuries miners have been digging tortuous tunnels deep into the earth in the quest for coal and ore. The development of open pit mining on a large scale is a relatively new phase, but already it has become of great importance in the mining industry. During the average year, the open-pit mines of this country produce approximately 19 million tons of coal, 24 million tons of copper ore, 32 million tons of iron ore, nearly three million tons of pebble phosphate, and about 150,000 tons of bauxite (aluminum ore).



LOADING NINE COAL CARS IN AN HOUR, WITH ONE SHOVEL

Digging into a coal vein which averages 25 feet in thickness, this new shovel can dig and load 5000 tons of coal in a 10-hour shift. Note the electric locomotive hauling the coal cars

Unbreakable Movie Film

Steel-Sheathed Film Reduces Replacement Costs; Has Great Educational Value

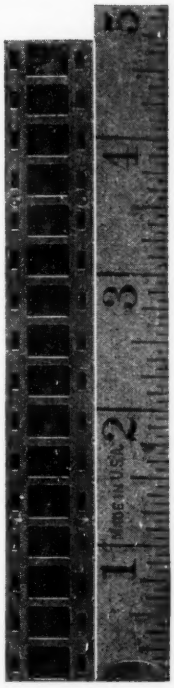
FROM the earliest development of motion pictures to the present day, the most costly, annoying, and wasteful defects in projection methods have been the breaking and scratching of film. The cost of renewal prints aggregates millions of dollars each year.

In the rapidly developing use of 16-millimeter or "narrow width" film, which is only six one-thousandths of an inch thick, film breakage is even a greater problem. Millions of dollars have been lost in attempts to develop 16-millimeter projectors with break-proof film for advertising, educational, and "nickel-in-the-slot" motion picture purposes. Projectors for these fields must operate hour after hour and day after day, thus requiring the film to run through the mechanism thousands of times.

The accompanying photographs illustrate the Dramagraph, a recent invention of Van Dyke Hill, of the Dramagraph Motion Picture Corporation, New York City. The outstanding feature of this projector is the steel-clad, break-proof film used therein, and the method of projecting these strips in a connected sequence to give an unbroken picture on the screen.

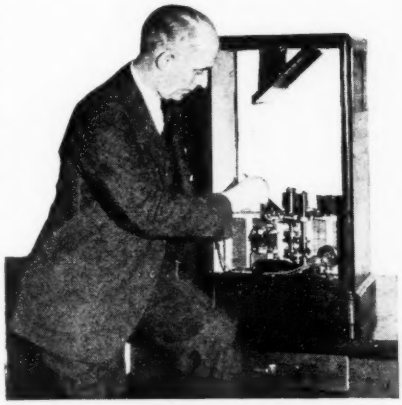
The film, cut in 4¾-inch lengths, is sealed between two pieces of thin steel through which an aperture for each frame has been punched and along the edges of which are a number of holes that are equivalent to the sprocket holes in the film. Each film section is equal in length to 16 pictures or approximately 1 second of projection; hence a hundred feet of 16-millimeter film can be loaded into 250 sections.

The sections are stacked horizontally in recesses in the main casting of the projector. Over one recess, or magazine, is an electro-magnet which draws the top section into a breach located at one end of a horizontal track. Claws operating from an intermittently moving shuttle engage the holes along the edge of the frames and progressively move the sections across the bridge to the take-up magazine. Located mid-way of the bridge is the light aperture through which the beam of light emanating from a 100-watt lamp is directed vertically through the film and lens. This beam is deflected along a horizontal axis onto a translucent screen by a superimposed mirror.



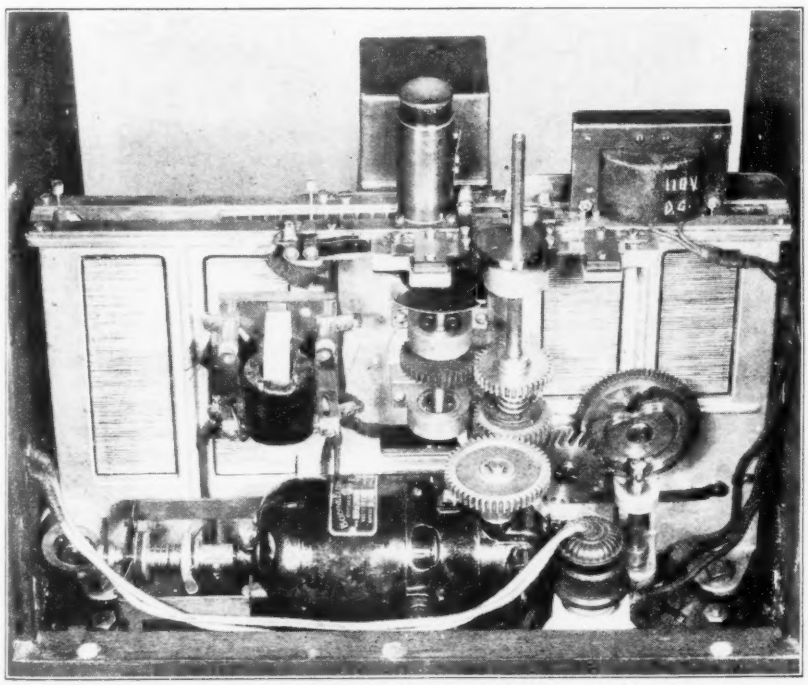
UNBREAKABLE

A sixteen - frame section of 16-millimeter film in its steel protector, compared to an inch rule, at the right



THE PROJECTOR APPARATUS

The light beam is projected upward and is turned through an angle by the mirror



THE INTERIOR MECHANISM

The 4¾-inch sections stacked in the magazine at the right, are drawn upward by a magnet, to the left through the light beam under the lenses in center, and into magazine at the left

AFTER the film sections have passed beyond the aperture, they drop by gravity into the take-up magazine, at the bottom of which is a horizontal conveyor chain equipped with claws which slide the bottom sections off and convey each synchronously to a lifting mechanism at the bottom of the feed magazine. This lifting mechanism elevates each individual frame to a point above a group of spreading pawls which support the stack of frames in the feed magazine.

The frames thus travel upwardly, across the bridge, down through the take-up magazine and return horizontally to the bottom of the feed magazine, the movements being perfectly synchronized. Test runs exceeding 15,000 passages through the system have shown no wear whatever upon the film.

Plans have been made to introduce this type of projector in museums of natural history, libraries, art museums, medical and technical schools, and similar institutions in a form whereby students or visitors can operate motion pictures at will by the mere pressing of a button. The invention will also be used with 35-millimeter film for projecting 10-foot wide motion picture advertising posters in natural colors through translucent screens.

Substituting for Sunlight

Has a New Era of Artificial Lighting Arrived? Illumination That Approximates Sunlight Is Foreshadowed

By M. LUCKIESH

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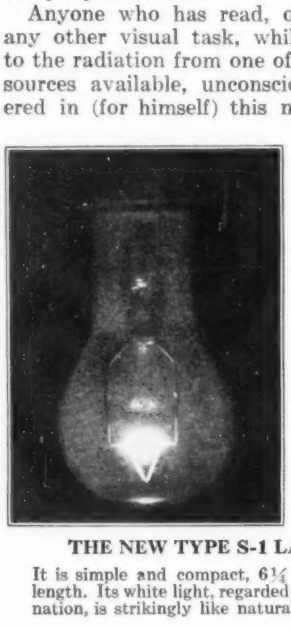
FOR many centuries man has recognized instinctively, or through vague experience, that sunlight is directly or indirectly involved in life processes. During recent years scientific research has firmly established many interesting facts. Ultra-violet radiation was discovered over a century ago, but only during recent years has its influence upon health been established. Much scientific research is needed to fill the many gaps in our knowledge of curative and health-maintaining value of solar radiation. However, we have sufficient scientific knowledge of the beneficial effects of sunlight which, combined with a justifiable recognition of the general importance of sunlight as an ever-present environmental factor, leads us to look forward to the possibility of a new era of lighting with simulated sunlight.

SUCH a point of view, while admitting the desirability of much more scientific knowledge than is available at present, avoids the necessity of making detailed claims for simulated sunlight produced artificially. If an artificial source of radiation emits energy throughout the spectral range of solar radiation (to λ2900) and is found to be an effective substitute for sunlight in those phases of health maintenance and of curative effects which have been established for sunlight, we who light the world are justified in preparing for the opening of a new era of lighting. During the past few years we have been passing through the rudimentary stage of lighting for health as well as vision.

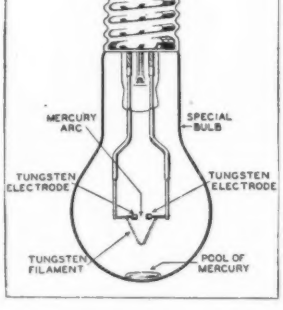
Professional practitioners of radiation therapy, manufacturers of devices which supply ultra-violet radiation, and users of "home treatment" apparatus have not generally recognized the past decade as an evolutionary stage. However, it has been just that. Light for vision is emitted by all the practicable sources of ultra-violet radiation. Up to the present time, the use of the light for vision has been ignored and the effects of ultra-violet radiation have been emphasized, while outdoors throughout the ages man has used sunlight for vision and the health benefits have been ignored or at most have been secondary in his consciousness. With certain beneficial effects established it is logical that we are now ready to consider lighting for health, as a possible adjunct or result of artificial sunlight, incidental in our consciousness as we proceed with our everyday activities.

Anyone who has read, or pursued any other visual task, while exposed to the radiation from one of the many sources available, unconsciously ushered in (for himself) this new era of lighting for health as well as vision. For this act to spread throughout our world of human activities it is necessary that the illuminant contain insufficient radiation of such wavelengths as are harmful to the eyes. Naturally solar radiation, excepting in extreme cases such as reflection from snow, produces beneficial results without the production of conjunctivitis[1] or other known injury. Artificial sources of health maintaining radiation, in order to be used widely for this extended purpose, must meet certain requirements already firmly established in lighting practice. Convenience, safety, simplicity, flexibility are important factors in lighting. The quality or color value of the light must be acceptable.



THE NEW TYPE S-1 LAMP

It is simple and compact, 6¼ inches in length. Its white light, regarded as illumination, is strikingly like natural sunlight



We have available some of the old sources such as carbon arcs, the mercury arc, tungsten filament lamps, and new sources such as the tungsten-mercury Type S-1 lamp and, of course, further new developments. We have sunlight to utilize with special ultra-violet transmitting glass, but artificial light has long ago become an essential to our indoor world. Nearly everyone spends sufficient time under artificial light, and its cost has long ago come within the range of the cost of daylight, so that we may look upon it very generally as an adequate dispenser of the health-maintaining radiation which apparently is chiefly confined to the region between λ2800 and λ3100.[2]

THE sources of light and suitable ultra-violet radiation can readily be screened or so installed in fixtures that the rays that are harmful to the eyes are absorbed by proper transmitting or reflecting media. Already we have a great supply of such data pertaining to the spectral transmission and reflection of common media. But those heretofore interested in lighting must alter their point of view, for materials which conserve light do not necessarily conserve the valuable ultra-violet radiation.

Among the metals, chromium and aluminum reflect quite well throughout the visible and important ultra-violet regions. Oxidized aluminum is particularly efficient throughout this range. Among the white pigments which are approximately equally efficient reflectors of light for vision there is a great diversity in their ability to reflect ultra-violet radiation for health. For example, zinc oxide reflects very little ultra-violet radiation, its absorption being almost complete for radiations shorter than λ3900—the limits of the visible spectrum. Although titanium pigment, lithopone, and tin oxide efficiently reflect radiation of shorter wavelengths, none of them reflects

[1] Conjunctivitis is inflammation of the outer membrane of the eye.—*The Editor.*

[2] The Greek letter λ is a conventional symbol to indicate the wavelength of radiation in Angstrom Units, one Angstrom Unit being a ten billionth of a meter. Radiation of wavelengths in the region between λ2800 and λ3100 Angstrom Units, mentioned by the author, would be in the ultra-violet.—*The Editor.*

appreciable energy in the vital region between λ2800 and λ3100. White lead reflects fairly well in this region.

The vehicles in which pigments are used in paints and enamels are likewise important. A common mistake is the use of vitrified white enamel reflectors for ultra-violet sources. The "glass" carrier of the pigment absorbs the desired ultra-violet energy. In fact, a black paint is practically as efficient for reflecting this energy as the common porcelain enamels, and graphite is better than several common white pigments.

Transparent glass can be made to transmit as far into the ultra-violet region as desired. Quartz transmits efficiently much farther than desired for the purpose under discussion. Translucent quartz can be produced at reasonable cost to be practicable in fixtures for this new era. Between quartz and common glass there are many possibilities. Apparently, purity of materials commonly used in glass is all that is necessary to extend the transmission to λ2800. However, iron oxide as an impurity is the greatest nuisance. It must be reduced to 0.01 percent if high transmission is to be obtained, even as far as λ2970, which is the region of greatest effectiveness in the cure of rickets and in the production of erythema or reddened skin.

THE production of erythema is important as a step between energy measurements and physiological action. It is also important because it is a visible and sometimes painful result of exposure to ultra-violet radiation. We have found that measurements of energy at λ2968 or λ3024, emitted by the mercury arc, are directly correlative with erythemal effectiveness. In other words, the production of erythema is directly proportional to the quantity of energy in either of these wavelengths. There are indications that this holds approximately for other sources.

Exposure consists of the quantity of energy per unit area and the duration of the application. Exposure to a quartz mercury arc at a distance of 30 inches for a period of five to ten minutes is sufficient to prevent and cure rickets if applied only once or twice a week. Obviously this is entirely too potent to be used in lighting where persons are exposed hours daily, unless the intensity of illumination is greatly reduced. Of course, with such an illuminant goggles would have to be worn in order to protect the eyes. This emphasizes one of the qualifications of an illuminant suitable for this extended lighting purpose. A suitable glass for filtering out too potent radiations can be used with the mercury arc, and such glass is being experimented with. Likewise, any source can be made safe for the eyes.

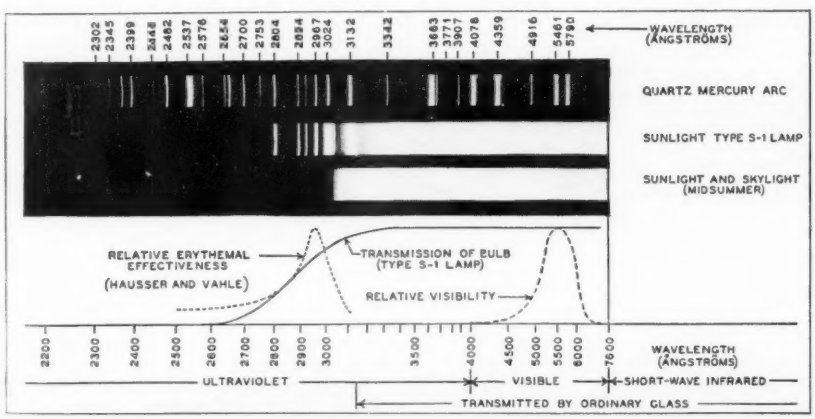
In our study of the tungsten-mercury arc (Type S-1 lamp) we found that the reciprocity law held for erythemal effectiveness over a range of 25 to 400 foot-candles. In other words, an exposure of 10 minutes' duration at 400 foot-candles produced the same degree of erythema as an exposure of 160 minutes at 25 foot-candles.

This brings up the question as to the necessity of producing erythema in order to obtain health benefits. Much evidence points to no such need. In fact, our common experience with sunlight is usually without erythemal result, still we feel that it does us good. Consideration of this question is also connected with that of the minimal quantity necessary to obtain health benefit. Prof. R. Adams Dutcher reported to me several years ago the results obtained with an ordinary 50-watt tungsten-filament lamp on rats which were fed upon a restricted diet. This small lamp was operated in their cage from six to eight hours per day. In three weeks their bone-ash was more than twice that of the control group which was kept in darkness.[3]

This experiment seemed worth repeating, so we made some 500-watt tungsten-filament lamps in special bulbs. Doctor George H. Maughan at Cornell University found that under 20 foot-candles of this illuminant for eight hours per day appreciable improvement was made by chickens which initially had severe rickets. Doctor H. J. Gerstenberger of the Babies' and Childrens' Hospital in Cleveland co-operated with me by using the radiation from this tungsten-filament lamp upon guinea pigs fed upon a restricted diet.[4] For several weeks rickets was warded off.

In this brief account space does not permit going afield or into detail. However, I have given glimpses of dependable data at both ends of the scale—extremely mild and extremely potent ultra-violet radiation. I have obtained sufficient data during recent years with this extended purpose of lighting in mind to feel encouraged to venture into a new era of lighting. I am certain that results can be obtained by means of a properly safeguarded illuminant at the foot-candles required in modern lighting. Many questions still arise. For example, is a substitute for sunlight when used in lighting for health as well as vision a substitute for vitamins? In the case of rickets it has been proved to be an adequate substitute for vitamin D. Whether or not it is a complete substitute need not concern us unduly because people must eat.

IN considering health maintenance along with lighting for vision we are confronted with the same questions as arise in the use of "health equipment" in the home. Much more research has been directed toward the cure of disease than toward the maintenance of health. At first glance it may appear to be impossible to prove whether a group of persons in normal health is aided in maintaining that state of health by exposure to ultra-violet radiation. However, research can establish a good deal along the line of prevention. It has been proved that rickets is prevented by 15 minutes' daily exposure of the body to adequate sunlight. There is some evidence that colds are less prevalent in a group of persons treated with ultra-violet radiation than in a group not treated. Medical men advise sunlight for health maintenance. Certainly interiors should be freed of some of the germs when illuminated by sources emitting ultra-violet radiation between λ2800 and λ3600 which has been proved to be germicidal.



SPECTRAL CHARACTERISTICS OF THE SUNLIGHT TYPE S-1 LAMP

The diagram will repay detailed study for it reveals very many significant facts

[3] Rickets is a bone-deficiency disease often caused by lack of enough ultra-violet of proper wavelength to cause the bone-forming elements of the diet to be deposited in the bones. In experiments on rats the amount of bone-ash found after the animal has been killed at the end of the experiment bears a relation to the amount of ultra-violet of appropriate wavelength that it has had.—*The Editor.*

[4] In making experiments of this kind on animals it is usual, in order to exclude as far as possible outside factors which might confuse the results determined at the end, to restrict the diet to food elements which do not themselves tend to prevent the occurrence of rickets.—*The Editor.*

All photographs courtesy Buffalo Museum of Science

THE BUFFALO MUSEUM OF SCIENCE

A modern adaptation of classical architecture gives the severe lines appropriate for a science museum. The approach is 100 feet wide. Most of the exhibition halls are illuminated with artificial light only, and many of the animal groups are in miniature form, conserving space

A Friendly Museum

Doing Away With the Disease Called "Museum Fatigue" by Skillful Planning and Lighting

IN the dedication address at the formal opening of The Buffalo Museum of Science, the President, Mr. Chauncey J. Hamlin, aptly described the function of a museum which is often lost to view. He said: "The value of a museum to its community must be measured in terms of service to the citizens of that community. In order to render the largest measure of service possible the museum must be dynamic and not static; it must be not a storage warehouse of dead objects but a hive of spontaneous activity, ever storing up the honey of pleasant memories of having brought a larger share of happiness and joy through opening up fuller and wider horizons of knowledge to a constantly growing circle of friends."

It was with this end in view that the Buffalo Museum of Science was built. The Buffalo Society of Natural Sciences dates from 1858, so there is a real historical background. There are many features of the museum which are unique. It is neither too large or too small. It is not "highbrow," yet it is not at any time unscientific. A pleasure is in store for all who visit Buffalo. The activities of the staff are really remarkable and the organization is a model one. An investment of 2,000,000 dollars has been wisely made. Other cities have science museums either in whole or in part, but this museum has great points of difference which we will endeavor to explain. The museum is located in Humboldt

THE CENTRAL HALL

The artificially lighted exhibition halls open from the great central hall and display the whole circle of the sciences. The exhibits are all so beautifully balanced that the visitor does not tire easily

Park and while the location might have been made more central, the effort expended in getting there will be well repaid.

The building of Indiana limestone appears to be two stories in height set on a high base. Actually it contains a high ground floor story with three floors above it, although the upper floor does not show in the exterior.

The architects were requested to do everything possible to avoid that dread disease known as "museum fatigue." The architects decided that the malady was caused mainly by three things: First, hard floors; second, eye fatigue caused by the necessity of constantly shifting the foci of the eyes from the usual high ceilings in museums down to a nearby exhibit, this often being accentuated by the daylight from the clerestory windows or skylights; third, reflections from the exhibit cases.

To avoid hard floors, rubber and linoleum surfaces were used. To remedy the second cause of fatigue, the ten exhibit rooms were built with rather low ceilings and are softly illuminated by direct artificial lighting. A special exhibit case and plan of lighting were designed to meet the third difficulty.

The usual exhibit case is illuminated by lighting the room brightly and borrowing that light for the exhibit cases. The reason that the lights cannot be placed directly within the cases is because many exhibits are of wax, and they would be destroyed by the heat from the lamps, and it is necessary that all exhibit cases be air- and dust-tight. Fortunately, in the Buffalo Museum, it was decided to use many photographic transparencies to compose an illustrated guidebook to each room. This allowed the exhibit cases to be designed with the electric lights so arranged that they illuminate the transparencies directly but are separated from the exhibit.

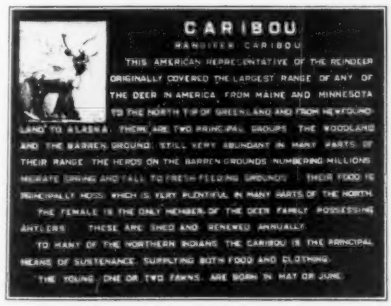
Off the central hall are a series of rooms devoted to physics, astronomy, geology, biology, invertebrates, vertebrates, evolution, heredity and environment, human geography and climate, and primitive races. In the rear is a large hall of plant life. On the second floor are the offices and library; an aquarium room is over the hall of plant life. The third floor contains the laboratories and preparation rooms which are splendidly equipped. On the ground floor is the auditorium, a cafeteria, offices, and a children's museum with a separate entrance.

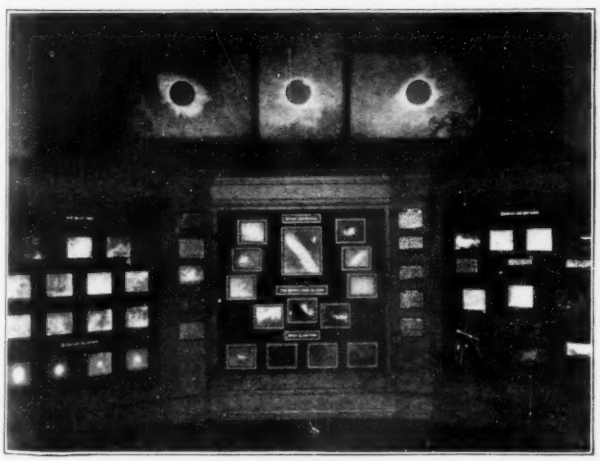
MAKING ARTIFICIAL FOLIAGE

The extensive laboratories and preparation rooms are on the upper floor

ILLUMINATED LABELS

The group shown at the right is in miniature and illuminated labels at the side serve to interpret the group. The labels [below] incorporate text and a picture of the animal itself


CARIBOU
RANGIFER CARIBOU
THIS AMERICAN REPRESENTATIVE OF THE REINDEER ORIGINALLY COVERED THE LARGEST RANGE OF ANY OF THE DEER IN AMERICA, FROM MAINE AND MINNESOTA TO THE NORTH TIP OF GREENLAND AND FROM NEWFOUNDLAND TO ALASKA. THERE ARE TWO PRINCIPAL GROUPS, THE WOODLAND AND THE BARREN GROUND, STILL VERY ABUNDANT IN MANY PARTS OF THEIR RANGE. THE HERDS ON THE BARREN GROUNDS, NUMBERING MILLIONS, MIGRATE SPRING AND FALL TO FRESH FEEDING GROUNDS. THEIR FOOD IS PRINCIPALLY MOSS, WHICH IS VERY PLENTIFUL IN MANY PARTS OF THE NORTH. THE FEMALE IS THE ONLY MEMBER OF THE DEER FAMILY POSSESSING ANTLERS. THESE ARE SHED AND RENEWED ANNUALLY. TO MANY OF THE NORTHERN INDIANS, THE CARIBOU IS THE PRINCIPAL MEANS OF SUSTENANCE, SUPPLYING BOTH FOOD AND CLOTHING. THE YOUNG, ONE OR TWO FAWNS, ARE BORN IN MAY OR JUNE.



THE ASTRONOMY ROOM

The photographs are all illuminated as are all the labels, producing an excellent effect. Such exhibits have great educational value

BUDDING SCIENTISTS

The children have their own museum, their own library, and even their own private entrance to them. They enjoy their privileges

Some Famous Centenarians

There Is No Recipe for Longevity, Which Is Mainly Hereditary. However, a Milk Diet Seems to Favor Long Life

By JAMES A. TOBEY
Doctor of Public Health

NINE persons who had reached the age of 100 or over died in Ohio in 1928, according to an item in a recent issue of the *Journal of the American Medical Association*. Of these nine centenarians, five of whom were women, one was stated to have been 114, according to her original birth certificate. The average age of the nine was said to have been 103 years and six months.

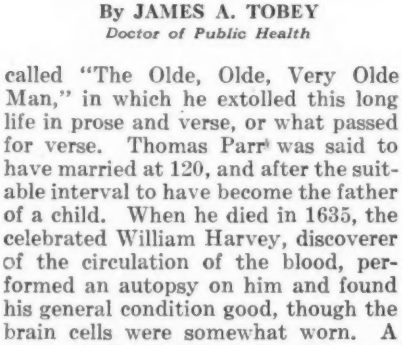
Many individuals are asserted to have lived more than 100 years, but most of the reputed centenarians are found on rigid investigations not to be centenarians at all. The age of a very old person seems to be one of the matters most susceptible to deviation from the truth, for memories are usually hazy in the extremely old, and the relatives, friends, and neighbors of these patriarchs seem always ready to exaggerate their antiquity. A few years ago a Kentuckian named John Shell received considerable notoriety as being 131 years of age, but a somewhat searching inquiry revealed him to be not more than 100, if he were even that.

IN 1904 a Russian newspaper calmly reported the death at the advanced age of 180 of a woman named Therese Abalva. Another Russian newspaper in 1926 was more modest, for it allotted only 138 years to Ivan Tretya, a peasant of Rostov. A Hungarian farmer, Peter Zortay or Torton, exceeded them all for he was supposed to have been 185 when he died in 1724; as was also St. Mongah, whose death occurred in 1781. Some months ago Henri Barbusse, the French author, recounted his visit in Georgia in Transcaucasia to Nikolai Andreyevitch Shapkovsky, who was reputed to be between 142 and 147.

The cautious reader will regard these allegations with as much skepticism as interest.

One of the most famous of the very aged persons of history was Old Parr, who was said to have been born in England in 1483 and to have died there in 1635. He was working blissfully as a farm laborer at the tender age of 152 when an interested nobleman, the Earl of Arundel, whisked him off to London and put him on exhibition. The fast life of the metropolis proved too much for him and he promptly succumbed. Thereupon, one John Taylor, known as the "Water Poet," got out a book called "The Olde, Olde, Very Olde Man," in which he extolled this long life in prose and verse, or what passed for verse. Thomas Parr was said to have married at 120, and after the suitable interval to have become the father of a child. When he died in 1635, the celebrated William Harvey, discoverer of the circulation of the blood, performed an autopsy on him and found his general condition good, though the brain cells were somewhat worn. A reprint of Taylor's book was issued by James Caulfield of London in 1794.

Old Parr's unusual age was accepted



NOT MORE THAN 100

Old Parr claimed to have been 152 years old, but unkind investigators proved he was mistaken by 50 years, more or less

until 1873 when Mr. W. J. Thoms, deputy librarian of the House of Lords, who was so unkind as to make a real investigation of the case, concluded that about 50 years had been improperly tacked on to the actual life of Parr. The gentleman was a real centenarian, but little more than that.

Mr. Thoms also exposed two other notorious long-lifers. A certain Countess of Desmond was credited with 140 years, but the doubting librarian showed that the ages of two separate countesses of the same name had been added together; instead of one person living to 140 years, two ladies had each lived about 70. Thoms examined, in all, 22 cases of alleged longevity and found that none of the records sustained the contentions of centenarianism.

A writer familiar with Mr. Thom's iconoclasm on this subject, a Mr. John B. Bailey, wrote a book in 1888 which he called "Modern Methuselahs," and in it he cited a number of instances of well-known centenarians and nonogenarians.

He began with St. Anthony, who was said to have lived to 105, but most of his other examples, such as the Emperor Cantacuzenus of the 14th Century, Pletho, Cornaro, Titian, de Fontenelle, and Amory, were only 99 or 100. The author, however, did list a dozen cases which he believed to have been actually 100 years old or more. This writer waxed philosophical in his final chapter and, while admitting that these human century plants reached their great ages in spite of a diverse variety of habits, offered a recipe for longevity. His three essentials for "long-lasting" were: good heredity, good digestion, and bodily and mental activity. He quoted these words of Sir Benjamin Brodie, "Men have been known to die, literally speaking, of disease induced by intellectual vacuity."

ONE of the best surveys of centenarians was made in 1899 by T. R. Young, former president of the British Institute of Actuaries. At that time he could find only 22 indisputable instances of such aged persons, but in a second edition published in 1905, he added eight more. The longest authentic life he could discover was one of nearly 111 years. Mr. Young discusses all of the previous works on longevity, of which there had been a considerable number, such as the works of Flourens in 1855, of Pinney in 1856, and of Humphry in 1889, as well as that of Bailey alluded to above. Contrast the conservatism of Young with the exuberance of one James Easton, who in 1799 got out a book listing 1712 persons who had lived 100 years or more between 66 A.D. and 1799 A.D. Old Parr and the Countess of Desmond were both on his list.

In a rather weighty tome on the prolongation of life, Professor Eli Metchnikoff, the famous bacteriologist, hazarded the opinion some 20 years ago that human life ought to average at least 120 years. In his book he describes various persons who were supposed to have attained great ages. Among them were Marie Priou, who died in 1838 at the alleged age of 158, after subsisting for most of her life on

cheese and goat's milk; and there was also Nicole Marco, who lived to be 110 on a diet of bread and milk.

The Metchnikoff formula for long life was to drink soured milk containing the Bulgarian bacillus, though he also recognized the value of hygiene and sanitation. Today it is known that it is not the B. Bulgaricus, but the acidophilus bacillus, in soured milk which exerts a favorable influence on the digestive tract and hence contributes to longevity. Metchnikoff's theories were based on observations on the vigor and longevity of various Balkan peoples who lived on such fare. It is claimed that Bulgaria has more than 3000 centenarians even today, while other Balkan countries such as Rumania and Turkey are likewise so favored.

A WOMAN, Maria Ustav, who died in Carcalia in Rumania in 1927, was asserted to have been 135, while Milo Frantsitch of Yugoslavia, who also died in 1927, was reputed to be 126. Zaro Ago of Constantinople was living there in 1928 at the alleged age of 145. These people are undeniably old; you can believe the actual ages given for them or not, as you think best. Personally, I have my doubts.

The alacrity with which newspaper writers seize upon convenient facts regarding supposed centenarians and exploit them in the press is well illustrated by the news story about old Nah-Nee-Num-Skuk, which appeared in the papers a year or so ago. This ancient red man was definitely asserted to have been born in 1809 and thus to have been 118 years old in 1928, but not one scintilla of real evidence of his age was offered, unless the fact that he had had six wives could be so considered. More than a mere statement of extreme old age is needed to be convincing. There is, unfortunately, no way to diagnose exact age from appearances or physical condition. Authentic birth records offer about the only reliable proof.

In the Massachusetts town of Shutesbury is a monument to one Ephraim Pratt, who is stated to have died there in 1804 in his 117th year. According to the inscription, "He swung a scythe 101 consecutive years and mounted a horse without assistance at the age of 110." An investigation of this case by Mr. Leon E. Whitney revealed that old Ephraim had indeed been a centenarian, but that he did not live more than 100 years. Mr. Pratt's longevity was attributed to his diet, which was said to have consisted chiefly of bread and milk.

The question arises as to whether diet may not actually have an effect on the length of human life. That it may do so is indicated rather definitely by some extensive experiments conducted in the laboratory of Professor Henry C. Sherman at Columbia University in New York. For more than ten years extensive nutritional investigations have been carried out there on white rats. In a study of 400 of these animals, it was found that by doubling the amount of powdered milk in the diet, a gain of exactly 10 percent resulted in the span of life for both the males and females.

In human experience (for studies on laboratory animals may properly be compared to it) this would indicate that at least six years could be added to human life by means of proper and optimal nutrition. Pure milk, the most nearly perfect of the foods of

NAH-NEE-NUM-SKUK, 120?

Born in 1809—according to the newspapers—this old Pottawatomie still was living at a Kansas reservation in 1928

man, was successful in lengthening life in this instance, and it is interesting to note that most of the famous true centenarians are reported to have subsisted largely on diets in which dairy products have been prominent.

Nutrition is, of course, only one of many factors which may influence longevity. The most important element in the ability to live long unquestionably is heredity. If all or most of our immediate ancestors attained to ripe old ages, generally well past the proverbial three score years and ten, it is likely that we shall also do so, provided we can escape the ravages of disease, avoid accidental death, and refrain from being hung for our sins.

Given two persons who, like Professor Sherman's rats, had exactly the same heredity and the same environmental conditions throughout life, the one who partook of an optimum diet during his entire existence would probably live longer than the one who had only an adequate diet. Such severe conditions are, however, practically never encountered, though there are instances of identical twins who have been separated in infancy and brought up under different environmental conditions, with the result that one has displayed an adult physique superior to that of his twin brother.

Most of the recipes for longevity are no more scientific than that given in a book printed in 1722 which revealed the secret of "rejuvenescency" of one Arnoldus de Villa. It consisted mainly of eating stewed vipers. Similarly, many of the warnings against practices which are stated to be sure to shorten life have little if any scientific foundation. Some of the current food faddists, for example, are vigorous in condemning white bread and attributing all of the ills of mankind to its use. The scientist realizes, however, that a diet with bread and milk as the basis comes as near to fulfilling average physiological needs as can any combination of known foods.

THE real centenarians are reported to have subsisted on all kinds of fare and have indulged in all sorts of hygienic practices. Some of them have eaten white bread, and some brown; some have smoked continuously and violently, and some never; some have partaken of the cup that cheers, and some have been total abstainers; some have trodden the primrose path, and some have been celibates; some have been cheerful, and some morose. Every centenarian usually attributes his longevity to his own peculiar mode of life, regardless of its correlation or lack of it with the accepted rules of hygiene.

The fact that some centenarians have reached great ages without special regard to hygiene is not, of course, an argument in favor of such a regimen. Luck may have been with them, and fate may have played its mysterious part. The average span of life has increased greatly in the last half century, though practically all of the increment has been in the ages below 50, particularly in the periods of early life. This increase has been due to many conditions, of which improved sanitation, better nutrition, more favorable economic circumstances, and biological influences are among the leading factors.

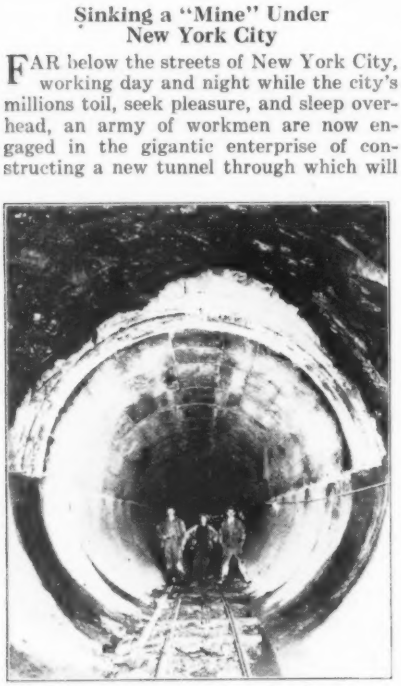
Although a regimen of life might be outlined for an individual case which ought theoretically to assist in prolonging that particular life, positive assurance could not be given of its success, because there are so many complicating factors. There is, in fact, no definite recipe for longevity, and the fountain of youth is still unknown, though science is nearer to the explanation than it ever has been and it may conceivably uncover the secret sooner or later. The average duration of life will unquestionably continue to increase and the mortality rate to decrease, until the biological limit has been reached. When that will be, no conservative scientist can foretell.

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Sinking a "Mine" Under New York City

FAR below the streets of New York City, working day and night while the city's millions toil, seek pleasure, and sleep overhead, an army of workmen are now engaged in the gigantic enterprise of constructing a new tunnel through which will



A tunnel of the New York City water supply system. The tunnel being built will be even larger

flow the additional millions of gallons of water daily needed to quench the thirst of the metropolis. Sixteen electric mine hoists and 62 mine locomotives are used in this project, for the work follows the same general lines as that necessary in mining.

The new tunnel, officially known as City Tunnel C Number 2, is being constructed by Patrick McGovern, Inc., for the Board of Water Supply. The mine hoists and locomotives which, with other electric equipment, were built by the General Electric Company, form the major part of the electric motor-driven machinery.

New York City now uses 875 million gallons of water per day, 30 percent of which comes from the Croton reservoir system, and 70 percent of which is supplied by Catskill water. The present distribution system has long been recognized as inadequate for future needs, and even at the present time is not large enough to maintain suitable pressure in the Boroughs of Brooklyn and Queens.

The new tunnel will run from the Hill View Reservoir, east through the Bronx, then south under the East River through Queens to Brooklyn, ending at Hamilton Avenue opposite Governor's Island. It will be 20.2 miles long, will be 17 feet in diameter when finished and will be at a depth of about 500 feet below sea level. Its construction will involve the sinking of 16 shafts from 14 to 32 feet in diameter, the depths of the different shafts varying from 500 to 850 feet, according to the land elevation. After the tunnel is completed, these shafts—with the exception of that at Hill View, to be used as an intake—will be used as risers to valve chambers from which the street mains will be supplied. The tunnel and shafts aggregating 22 miles linear measurement will be excavated to 19 feet diameter which will involve the blasting and removal of almost four million cubic yards of hard rock. Lining the tunnel to 17 feet diameter and incidental construction work will require the placing of 664,000 cubic yards of concrete. This work, together with other minor items, is to be completed in 70 months.

Electricity plays a vital part in the undertaking. Air for drills and shovels is furnished by 400-horsepower synchronous motor-driven compressors. As the muck is removed it is hauled through the tunnels to the hoists by storage-battery mine locomotives.

The mine hoists in the main shafts are each equipped with two cages in balance, one coming up as the other goes down. These cages are rectangular in shape, while the shaft is cylindrical, the space remaining being used for water pipes, air pipes, electric cables, et cetera.

Sixty-two seven-ton storage-battery mine locomotives will be used for haulage in the tunnel. These machines correspond in type to those used in the construction of the Cascade, Moffet, Hetch-Hetchy, Shandakin, and Cold Brook-Wachusett tunnels. Each locomotive is driven by two 12-horsepower motors, power for which is furnished by a storage battery consisting of 42 Exide cells. When the storage batteries are discharged, the locomotives are hoisted to the surface for recharging the batteries.

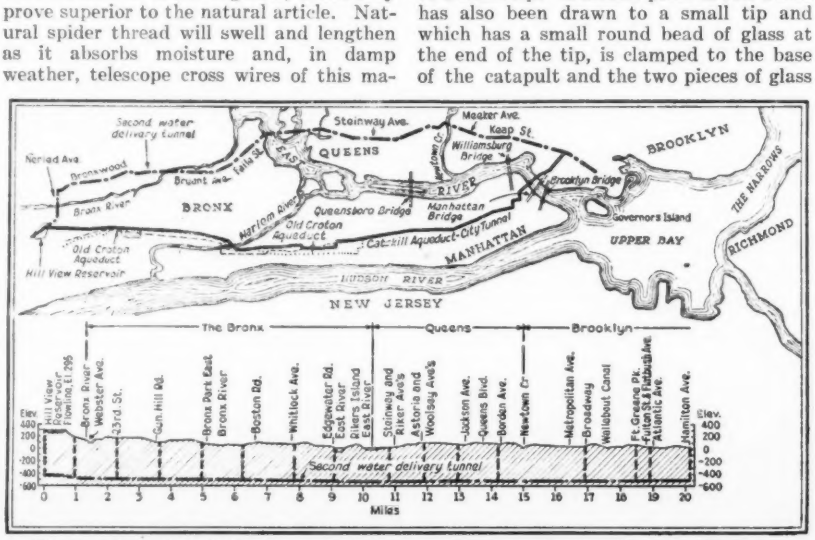
"Spider Threads" of Glass

SPIDER threads of spun glass, which rival in fineness those produced by the living insect, may easily be made by man and are of use for telescope cross wires in the instruments of the engineer, where they prove superior to the natural article. Natural spider thread will swell and lengthen as it absorbs moisture and, in damp weather, telescope cross wires of this material will buckle and sag, at least causing annoyance, or perhaps rendering the instrument useless for the time being. The replacement of these wires is at all times a delicate job and is particularly difficult in the field.

Glass fibers are not affected by dampness or by ordinary variations in temperature, are smooth, straight, and stiff, and do not need to be placed under tension in mounting. They may be drawn as fine as spider web without particular difficulty, with a very simple apparatus and a moderate amount of skill. They are remarkably strong and will stand a great deal of abuse. Being round and having a polished surface, they act as cylindrical reflectors; and light impinging upon them in the telescope is reflected away from the observer's eye, causing the wires to appear as dense black lines out to the edge, whereas spider thread, on the contrary, becomes translucent. It is, in consequence, easier to point the telescope so equipped upon the objective under adverse conditions of visibility.

Fibers used in telescopes of ordinary magnifying power, such as 30 diameters, will be from one to four ten-thousandths of an inch in diameter, depending upon the use of the instrument. Fibers as small as these can hardly be seen with the naked eye. They can easily be felt, however, and such a fiber of glass can be wound about the finger like common thread.

A convenient form of apparatus for drawing these fine fibers, and one which is easy to construct, is a catapult such as is shown in the diagram. This may be made of wood with an arm of some springy material such as hickory or ash. The end of the arm should have a hand-like cup for holding a small segment of glass rod. In operation this arm is held back by a trigger and a small section of glass rod, approximately one inch in length, is placed in it, one end of the rod having been drawn out to a small tip. A similar piece of rod which has also been drawn to a small tip and which has a small round bead of glass at the end of the tip, is clamped to the base of the catapult and the two pieces of glass



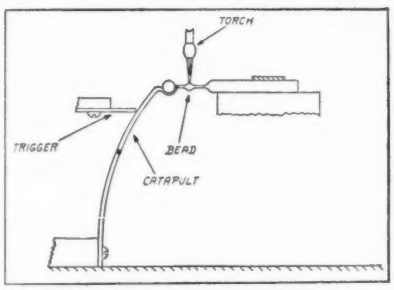
Plan and sectional diagram of the new water tunnel, showing, in the plan, the layout of the old tunnel. Note depth under familiar sections of the city

are then joined with a small blow-torch. As soon as this welding has been completed and the glass is cooled, a fine needlepoint of flame is directed upon the bead and as soon as this is a bright red color, the flame is withdrawn and the catapult sprung with the trigger. This act, because of the small quantity of glass involved, must be performed almost instantly and the withdrawal of the flame must slightly precede the springing of the trigger.

The small piece of rod in the catapult arm will be thrown a distance of several feet, drawing out the heated bead of glass behind it into a fine thread, the fineness of which will depend upon the size of the bead, the degree to which it has been heated, and the strength of the catapult arm. It is preferable to have the glass thrown over a dark cloth to assist in seeing the fiber, as it is almost invisible. With a little practice, very fine fibers may be made with this simple apparatus.

Bones Grown in Test Tubes

ALMOST amazing case of living tissue being grown outside the animal body is the growth of embryo gristle or cartilage into bone. This remarkable transformation has been accomplished by Miss Honor



"Spider threads of glass" can be made with this simple apparatus

B. Fell, working at the Strangeways Research Laboratory, Cambridge, England.

When the proper conditions of nourishment and temperature are maintained, isolated cells from animal embryos have been seen to grow and develop in the test tube just as if they were still in the animal body. Miss Fell, using a technique similar to one devised by the late Mr. Strangeways, has thus cultivated tiny pieces of gristle from six-day-old embryos of fowl. During cultivation, they increased to more than three times their original length and developed along practically normal lines.

Besides growing, these test tube cultivations have actually manufactured a substance called phosphatase, an enzyme, which is of immense interest to biochemists, Miss Fell and R. Robinson of the Lister Institute, London, have reported. When the tiny pieces of gristle were taken from the embryo, they contained no phosphatase at all.—*Science Service.*

The "Hush Hush" Locomotive, An Unusual Design

THE London and North Eastern Railway Company, England, have just completed a new locomotive of unique design for use on their East Coast Route express passenger services, and a number of trials have been run.

In outward appearance this new engine is an entire departure from previous practice in locomotive design in England and many of the constructional details are novel. The boiler has been constructed to the extreme limits of the railway gauge and there is no room for a stack to project above the boiler. The stack has, therefore, been sunk within casing plates which are arranged to throw the smoke upwards and clear of the engineer's view from his position on the footplate.

Considerable experimenting was undertaken and the outstanding design was arrived at by tests which were made with a model of the locomotive in a wind tunnel with air currents of speeds up to 50 miles per hour. The results indicate a bold departure from the conventional appearance.

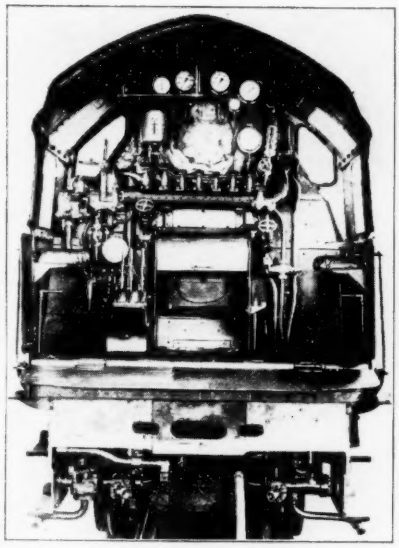
The locomotive possesses the unusually high boiler presure of 450 pounds per square inch, this being the highest pressure which has ever been used for a British railway locomotive. (The pressure hitherto used has been between 200 and 250 pounds.) This high pressure, which results in fuel economy, has necessitated the use of a boiler of the Yarrow water-tube type which has never before been applied to a locomotive.

The new engine possesses a 4-6-4 wheel arrangement known as the "Baltic" type, this being the first tender locomotive with this wheel arrangement to be constructed and operated in England. The six coupled driving wheels are six feet, eight inches in diameter.

One of the most striking features is that the whole of the air supplied to the firegrate is pre-heated, the supply being taken from the front of the smokebox, passing down a space between the boiler and the casings.

The engine is a four-cylinder compound. The two high-pressure cylinders, which are made of cast steel, (a new feature) are 12 inches in diameter and 26 inches stroke driving on to the leading coupled wheels. The two low-pressure cylinders are situated outside the frames and drive the intermediate pair of coupled wheels. Each of them has a diameter of 20 inches and a stroke of 26 inches.

The new engine has been constructed according to the designs and inventions of Mr. H. N. Gresley, C.B.E., Chief Mechanical Engineer of the London and North



The cab of the L.N.E.R. locomotive shown below. The engineer sits at the controls at the left

Eastern Railway Company. The engine was constructed at the railway company's works at Darlington, the high-pressure water-tube boiler being supplied by Yarrow and Company of Glasgow, well known makers of marine water-tube boilers.

No name has yet been given to this "hush hush" engine which after trials will be tested in actual service between London, King's Cross, and Edinburgh, Waverley.

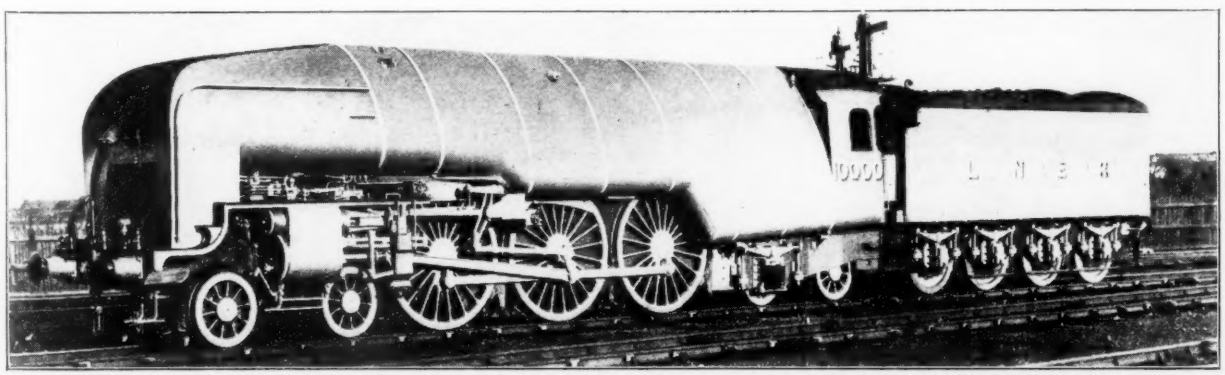
The engine is the longest and heaviest passenger locomotive in Great Britain, weighing, with its tender of the well known "Flying Scotsman" corridor type, nearly 170 tons.

Paper-Weight, Unbreakable Phonograph Records

"IS the 'Hit of the Week' out yet?"

"Yes, Madam," the newsdealer answers, and adds "It is a wonderful melody, too! I took one home last night and tried it out on my phonograph. Here you are. Fifteen cents please."

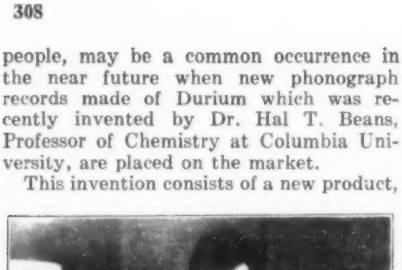
This conversation, mystifying to most



Principles of boiler construction new to British railway practice are embodied in this English locomotive

people, may be a common occurrence in the near future when new phonograph records made of Durium which was recently invented by Dr. Hal T. Beans, Professor of Chemistry at Columbia University, are placed on the market.

This invention consists of a new product,



Dr. Beans bends one of the phonograph records and pounds it with a hammer to show its durability

a resinoid substance which is a liquid in its original form but when subjected to heat becomes an insoluble, infusible solid, which combines hardness and flexibility to a remarkable degree. A thin film of this substance, which has been named Durium, is so hard that it can scarcely be broken with an ordinary hammer and is almost as flexible as a piece of paper. Associated with Dr. Beans in the development of Durium have been Dr. Louis Hammett and Dr. Geo. H. Walden, Jr., also of the Chemistry Department of Columbia University.

In making phonograph and sound-picture records by present methods, the plastic material of which they are formed is pressed in a heated mold so that a master die leaves its impression in the substance when it hardens. This is a slow process, however, because the metal molds must be cooled by artificial means before the molded record can be removed. The making of Durium records is simply a stamping process which may be practically as fast as ordinary mechanical printing.

The Durium phonograph record consists of a coating of only six or eight thousandths of an inch of Durium upon a heavy fiber paper. This paper is impregnated with Durium, passed through a drying room, cut into workable sections, passed rapidly through a stamping machine, and finally printed with titles in another machine. The die from which it is stamped is precisely the same as those used in making ordinary records.

As intimated in the first paragraph, these records, made in the company's own recording studio, will not be sold in music stores, but will be distributed to newsstands and sold therefrom for 15 cents each. Three celebrated figures in the world of music, Eddie Cantor, Florenz Ziegfeld, and Vincent Lopez have agreed to form a music jury to select the most popular song hit each week for recording.

The writer visited the Durium plant where he listened with amazement to the perfect tones of a Durium phonograph record which had already been test-played more than 200 times. The significance of this will be realized when it is known that the factory requirements for good tone reproduction of ordinary phonograph records is only 100 times. The writer also saw a Durium record hammered and scratched with great force with no apparent effect upon its tone quality.

Durium is being used at present for making "Hit of the Week" records and sound-picture records, but it is idle to speculate what its future uses in industry may be. Due to its heat-resistant quality it is effective for making matrices into which melted metal is cast, and since it can be applied with a spray, or with a brush, it may later be used as a paint where a fire-resistant waterproof surface is desirable—for example on the non-metallic parts of airplanes.

Preparing a "Square Meal" for the "Graf Zeppelin" in Brazil

AFTER the *Graf Zeppelin's* historic swing around the world in the almost unbelievable period of less than five days' flying time, it would seem that her forthcoming flight to Brazil and thence to the United States leaves little to stir the imagination. But such is not the case. A new difficulty, which for a time threatened to frustrate all the carefully conceived plans for this ambitious undertaking, set American engineers and chemists to scratching their heads in search of a solution.

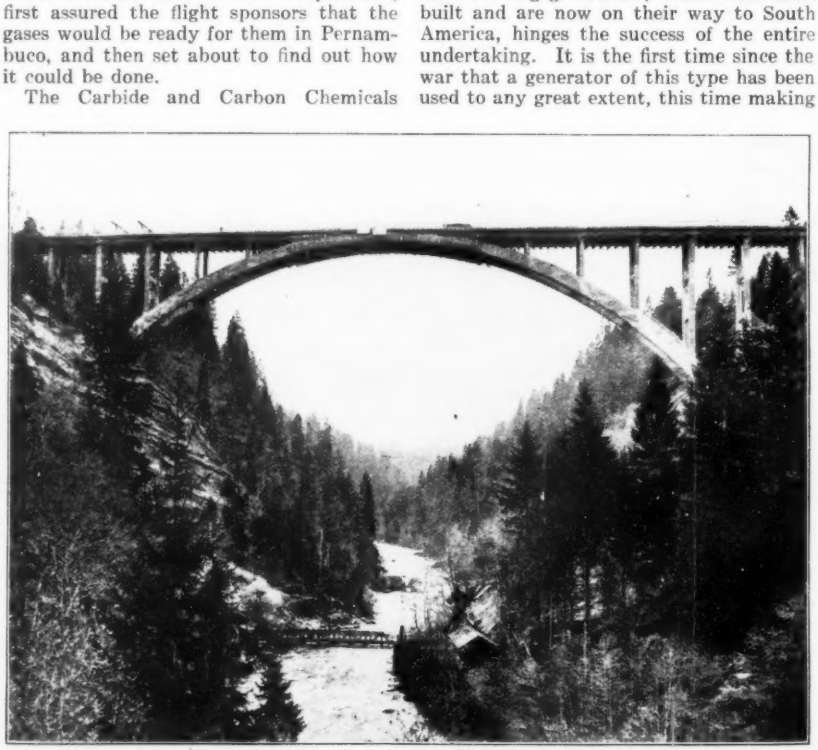
When the *Graf Zeppelin* lands at Pernambuco she will demand a "square meal" before turning northward to the United States. The American firm supplying both the lifting and fuel gas, the Carbide and Carbon Chemicals Division of the Union Carbide and Carbon Corporation, first assured the flight sponsors that the gases would be ready for them in Pernambuco, and then set about to find out how it could be done.

The Carbide and Carbon Chemicals Corporation had already perfected a fuel gas which had been used more successfully by the *Graf Zeppelin* on her previous flights than the blau gas originally used in Germany but now discarded in favor of the American type gas, even for use in Germany. This gas is a mixture of six parts hydrogen, and four parts Pyrofax. Pyrofax is a gas used commonly in the United States for cooking and lighting in sections not served by the gas mains. In refueling the Zeppelin in Tokio and Los Angeles, the Pyrofax was condensed to liquid form and shipped in tanks. Enough for the Brazilian refueling could be sent to Pernambuco in only 700 steel cylinders.

The hydrogen needed for combination with the Pyrofax has always been obtained at the refueling point. It is usually made in an electrolytic plant along with oxygen.

The refueling problem in Brazil seemed simple enough until it was learned that Pernambuco has no facilities for supplying hydrogen. The next difficulty encountered was the fact that to ship enough hydrogen to Brazil would require more than 4000 steel cylinders, more than could be spared in the entire United States. Furthermore, hydrogen cylinders may leak during the shipment and even if this were not so, the cost of shipping would be prohibitive. With no hydrogen available at Pernambuco and the impossibility of sending it there, Union Carbide officials were for a time checkmated.

But again lessons learned in the World War saved the day. Portable hydrogen generators had been successfully constructed and used during that crisis. This type of generator produces the hydrogen by the interaction of a caustic soda solution on ferro silicon in a covered tank. And so it happens that on two of these unpretentious looking generators, which have been built and are now on their way to South America, hinges the success of the entire undertaking. It is the first time since the war that a generator of this type has been used to any great extent, this time making



Near Echelbach in South Bavaria, this bridge, which is nearly complete, is said to be the highest concrete bridge in the world. It is 597 feet long, 246 feet high, and has a width of 52.5 feet. Built especially for automobiles, it will expedite vehicular traffic to the Passion Play at Oberammergau in 1930

the long ocean voyage in the cause of science and man's conquest of the elements.

The problem of refueling the huge ship centers on the fact that the lift must be kept constant at all times. This must be accomplished, furthermore, without valving off and consequently wasting the levitating gas, which in the case of the *Graf Zeppelin* is hydrogen. Although the fuel supply naturally diminishes as the flight proceeds, the Zeppelin's weight must nevertheless remain constant. The *Los Angeles*, using the non-explosive helium for levitation, accomplishes this by condensing the water of combustion from her exhausts. The gas perfected for the *Graf Zeppelin* is, like blau gas, about the same density as air and therefore no change in weight occurs as the gas is consumed.

Watermelon Seed Makes Useful Drug

AN extract made from watermelon seeds and given the technical name of cucurbocitrin has proved its usefulness in relieving many cases of high blood pressure, Drs. T. L. Althausen and William J. Kerr of the University of California Medical School have reported. These scientists stated that their work confirmed the results obtained with the watermelon seed extract by its discoverer, Dr. I. S. Barksdale, of Greenville, South Carolina.—*Science Service.*

Manna of the Exodus was Plant Exudate

THE manna which the children of Israel ate during their sojourn in the Sinai wilderness was the sap of a desert shrub, the tamarix, drawn off and predigested by insects and dried to hardness in the desert air.

The vexed question of just what was this food, which seemed miraculous to the hungry refugees from Pharaoh's wrath, has been investigated by a special expedition sent out by the Hebrew University of Jerusalem, under the leadership of Dr. F. S. Bodenheimer and Dr. O. Theodor. A brief report of their results has been sent to the English scientific magazine *Nature*.

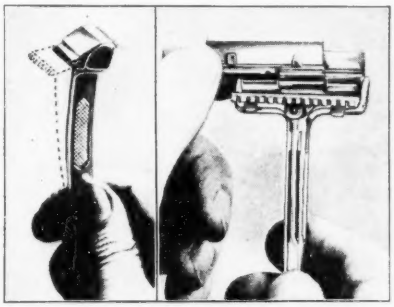
There has always been a dispute among scholars as to whether manna was an edible lichen, a low form of plant life that grows on the desert soil of the Sinai region, or whether it was the hardened sweet sap of the tamarix shrub. The studies of the expedition established that it is the same thing known elsewhere as "honey-dew"—the sap of the plant drawn off by aphids and exuded from their bodies. It is produced by one or two species of aphids on a single species of tamarix in sufficient quantity to form large drops that harden into sweetish grains of solid substance. Chemical analysis showed that it contains three varieties of sugar, as well as other compounds. —*Science Service.*

A Safety Razor That Sharpens Its Own Blade

AS you read the above title you will probably be as incredulous as we were when we first heard of it. Perhaps you will say "Impossible! Just a bit of hokum—another novelty to dupe unwise women looking for something new to give unsuspecting husbands." But we have examined this new safety razor thoroughly and it seems to be all that it is claimed to be.

Despite the fact that a great deal of research has been done on razors and safety-razor blades, very little is known concerning them. There is no formula by which a man with a certain type of beard may select a suitable razor. A man with a thickly growing beard may require a blade that has been sharpened with relatively large microscopic saw teeth, while one with a light beard may get a smooth shave with a wire edged blade, that is, one that has been sharpened down to an extremely thin and fragile edge. This new safety razor was designed to satisfy all types of beards. Because of the construction of this razor, which is produced by the DeHaven Razor Corporation, the edge is variable. The owner will, after a few mornings' experimentation, discover the edge most suitable to his particular beard and thereafter will sharpen his razor accordingly. Thus the razor has the quality of perpetual freshness.

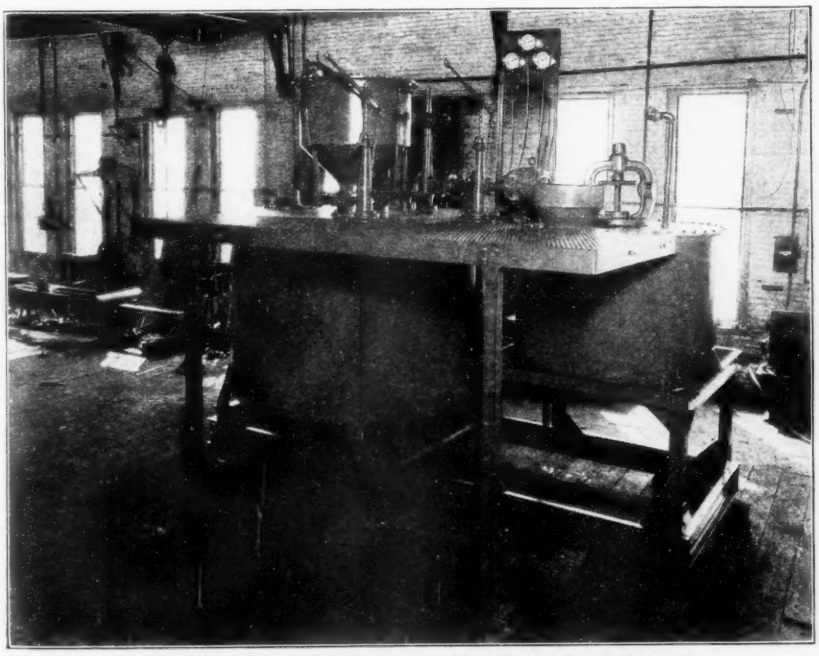
In appearance, the DeHaven razor seems but a variation of a conventional type of safety razor with a single-edged blade. The frame consists of a handle proper, with an upper cap which holds the blade



At left: **sharpening the new safety razor by shaking.** ***At right:*** **removing the blade for cleaning**

and which may be snapped open for cleaning or removing the blades. Inserted in a longitudinal slot of the main handle is a secondary handle which has a crossguard at the top just beneath the blade, and is pivoted at the lower end of the main handle so that it may be swung forward and backward in the main frame. Just beneath the edge of the blade on the guard is a piece of alloy steel which is roughened so that, when the swinging portion moves backward and forward, it hones the edge. The manufacturers supply a paste, to be rubbed on this honing surface, which contains a microscopic abrasive. A small amount of this paste wiped on the honing surface, a few jerks of the wrist, and the blade is sharpened.

Besides these features, the DeHaven razor is self-cleaning because when the movable part is flipped forward the underside of the blade is wiped clean. For final cleaning, the upper cap may be snapped back and the blade removed by sliding to one side. The stropping is always even due to the fact that the honing surface is swivel-mounted.



One of the generators which will "feed" the *Graf Zeppelin*

Australian Bushmen

HAVING purchased several months ago a photograph of a South African bushman with which a caption was supplied, erroneously describing him as an Australian bushman, we inadvertently allowed this error to be published. Realizing the mistake and having received from Mr. W. Lutge, Pinnaroo, South Australia, a letter on the subject, we desire to make amends and at the same time to correct the widespread impression that the Australian bushman is an aborigine. Part of Mr. Lutge's letter follows:

"It should be known that there is only one race of aborigines in Australia. They were of magnificent physique. They rarely interbred with the whites and are now nearly extinct. Colored people are so rare in Australia as to be regarded almost as a curiosity.

"The term 'bushman' is common enough and is synonymous with the American and Canadian 'backwoodsman.' In Australia, the bushmen are a fine type of white pioneers and belong to the class from which your much esteemed Lincoln was descended."

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

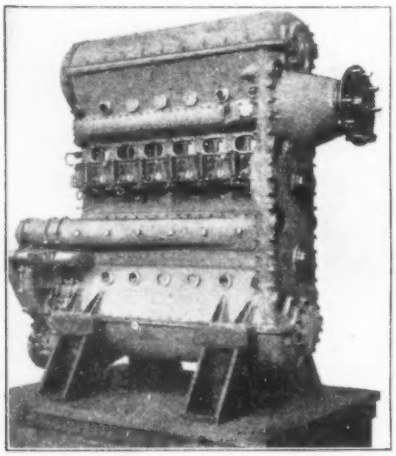
CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

The Junkers Diesel

AT the last meeting of the *Wissenschaftliche Gesellschaft für Luftfahrt* in Germany, Dr. Gasterstadt of the Junkers Company presented some preliminary information on the Junkers aircraft Diesel engine. A summary of this paper appears in a recent issue of *Automotive Industries*. The interest in aircraft Diesels is so keen at the moment that even partial information is valuable to us.

The engine is of the two-stroke double-



Side view of the Junkers Diesel aircraft engine, with the cylinders cast in a single block. The propeller shaft is geared to 2 crankshafts at the top and bottom

piston type, originally developed by the Junkers company for stationary purposes. Thanks, in part, to the high piston speed of 2160 feet per minute, the engine weighs only 2.6 pounds per horsepower and develops a total of 650 horsepower. There are six cylinders arranged vertically in a single block of a light alloy of aluminum and silicon. Two crankshafts are used, one at the top and one at the bottom of the vertical cylinder block. The block includes not only the cylinders but most of the two crankcases and the gear case at the forward end. Roller bearings are used on the crankshafts to save weight and make the engine compact. Five spur gears at the forward end connect the two crankshafts to the propeller. At an engine speed of 1500, the propeller turns at 1100 revolutions per minute. A double duralumin piston controls the exhaust and inlet ports.

A supercharger blows the air into the engine at 17 pounds per square inch, through scavenging ports so shaped that the air enters tangentially and keeps up its swirling motion until the end of the compression stroke. The supercharger is of the centrifugal type with the impeller driven from the rear end of the crankshaft.

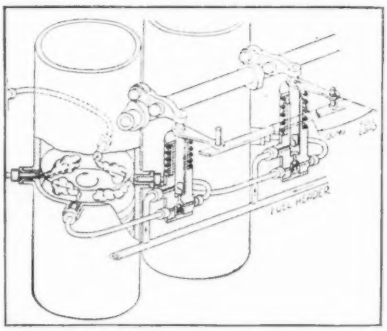
Four fuel nozzles are used for each cylinder, served by two pumps, one on each side of the cylinder. The nozzles are so shaped that the fuel leaves them in a fan-shaped spray inclined at 45 degrees to the piston heads. Owing to the quadruple spray and the swirling motion of the air induced by the inlet passages, there is a rapid intermixture of fuel and air, and low fuel consumption.

The fuel pumps are of straightforward design, with a simple mechanism for varying their stroke. The fuel consumption is only .365 pounds per horsepower, which is far less than that of a gasoline engine. The engine has seen 50 hours' flying service, including one non-stop flight of 8 hours' duration. Starting is accomplished by compressed air admitted to the engine cylinders, no special starting facilities being required.

An Interesting Ski

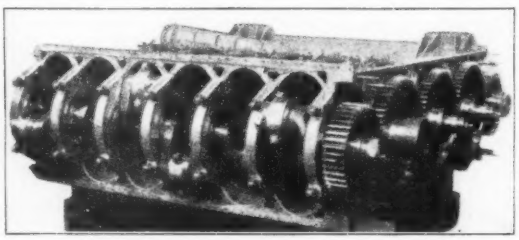
THE design of an airplane ski is a question of real engineering ability. The ski has to have such a surface that the impact on landing is sufficiently distributed, it must be able to stand up in rough landings, and it must be so pivoted that the airplane can change its attitude, as required, for the get-away or landing. The airplane landing gear employs shock-absorbing struts, and tires which are also capable of taking up shock. Hitherto skis have been built without the use of shock-absorbing devices but the Aircraft Products Corporation of America has now introduced a shock-absorbing member in its latest ski which is illustrated below.

The axle of the airplane is freely mounted in a rugged metal structure, the lower end of which is mounted on the after part of the ski, but which is free to turn about this lower end. Between this metal frame which is free to turn and the center of the ski proper, a shock-absorbing strut on the

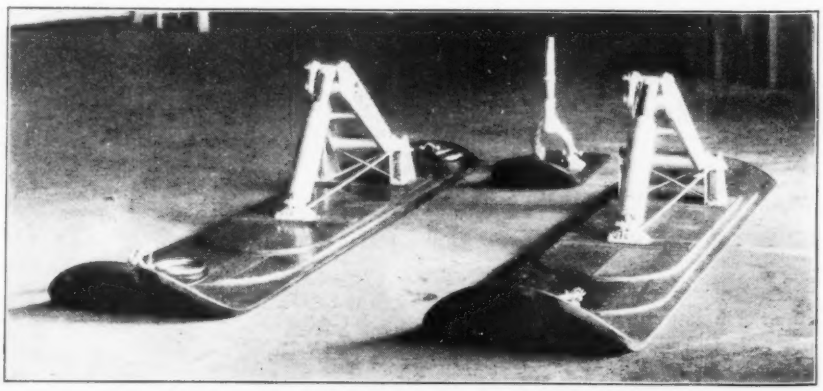


Fuel injection in the Junkers Diesel. Four nozzles, supplied by two pumps for each cylinder, supply a whirling spray which gives a quick mixture of fuel and air

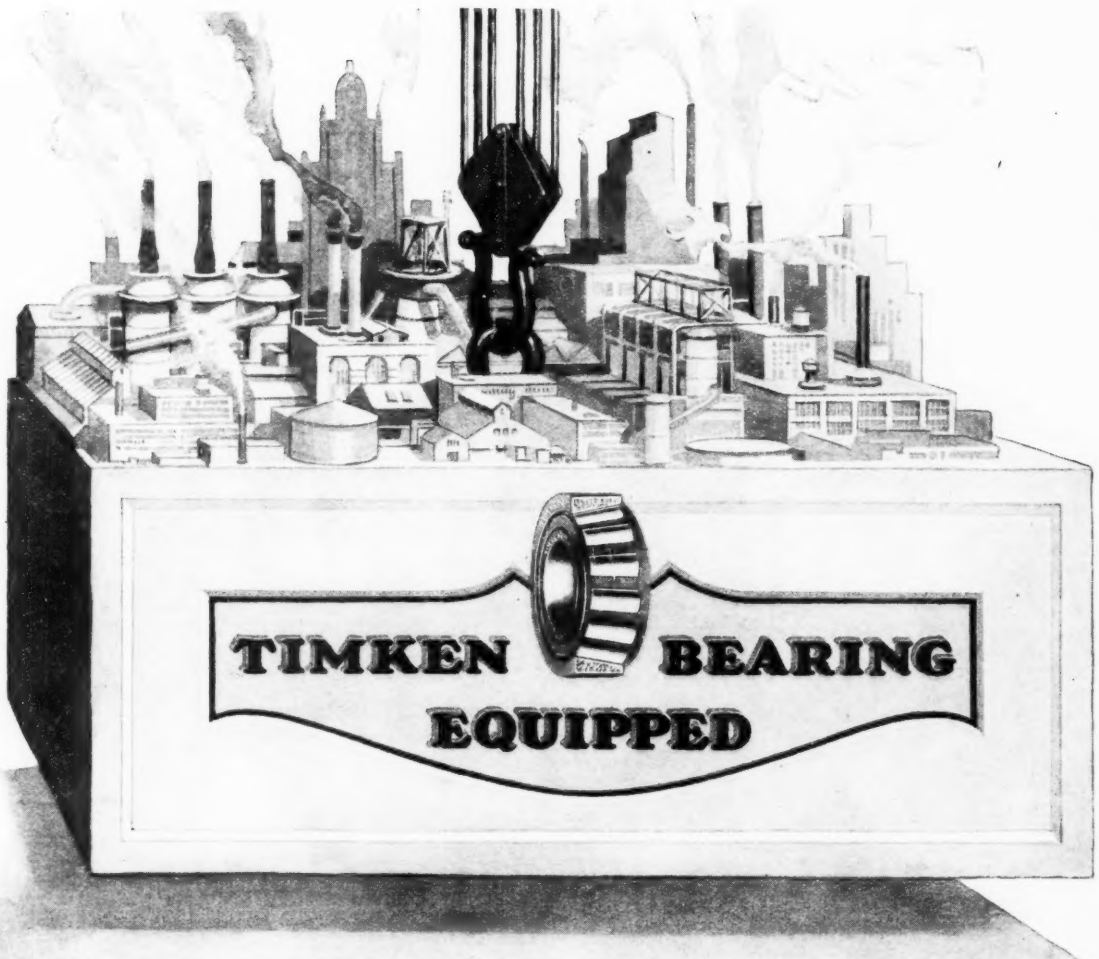
oil-hydraulic principle is introduced. Accordingly when the airplane lands, the shock is absorbed by the strut, which becomes shorter, while the metal frame moves down a little. The two coils of rubber cord at the front and rear ends of the ski are attached to the fuselage and prevent too great an angular motion of the ski as a whole. The introduction of shock-ab-



The Junkers Diesel with crank-case and gear covers removed, showing, at right, the gears which transmit power to the propeller



Airplane skis equipped with shock-absorbing struts



The Corner Stone of Industry

Friction or anti-friction is the difference between building upon a *sand* foundation or upon a *sound* foundation . . . "Timken Bearing Equipped".

Industry either lays itself wide open to Waste and pays a heavy friction-tax . . . or sets up a safeguard and reaps the resulting profits.

The kind of anti-friction protection is important . . . to select the bearing that carries *all* burdens, whether the load is all radial, all thrust, or both in any combination—the bearing that gives full protection based squarely upon Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

This group of exclusive Timken advantages puts production on a modern basis. Machine life becomes self-perpetuating. Power loss, lubricant and maintenance costs lose their significance and dwindle to decimals.

In lathe spindles or rolling mills; in steam shovels or mine cars or railroad trains—a wave of replacement surges over the nation—a protest against Waste—headed by the national symbol and safeguard—"Timken Bearing Equipped", the Corner Stone of Industry.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

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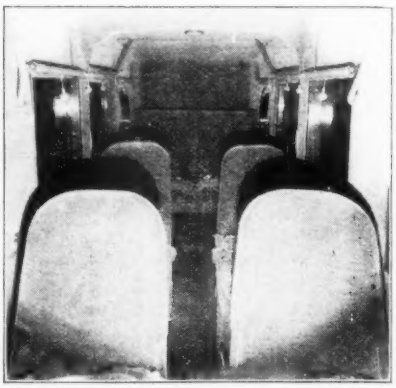
TIMKEN *Tapered Roller* **BEARINGS**

Above: A three-quarter front view of the Bellanca *Pacemaker* described below. *At Right:* Looking backward from the pilot's seat into the comfortable cabin



sorption in the ski is decidedly a step forward in cold weather operation.

Bellanca "Pacemaker"

AIRPLANE design has settled down to a steady process of evolution. There are no radical changes in appearance to be observed, but steady improvement in performance, carrying capacity, strength, and flying characteristics. Those of our readers who have seen the earlier Bellanca monoplanes will note from our photographs that the latest product, the *Pacemaker*, has apparently very similar features. The lifting struts, which combine the functions of bracing members with those of lifting surfaces, are still employed but there is a more graceful blending of wing and fuselage. The vision at the front end of the cabin almost attains perfection. The interior of the cabin, by skilful engineering, is freed of all obstructing structural members.

The performance and carrying capacity, as given by the company, are excellent. With a Wright J-6 of 300 horsepower, the *Pacemaker* has a useful load of 1937 pounds, which includes a pay load of 1042 pounds (pilot and 5 passengers), 112 gallons of gasoline, and 7 gallons of oil. Fully loaded the plane weighs 4300 pounds. The wing area is only 270 square feet. Even allowing for the lifting struts, the loading per square foot is high. Apparently our designers are willing to increase high speed even with the necessity of somewhat high landing speeds. Their argument is that the ever-increasing number of airports and landing fields makes the use of high landing speeds fairly safe.

The interior of the cabin is evidently quite attractive from the passenger's point of view. No effort has been spared to make the cabin of the *Pacemaker* as attractive and as comfortable as possible. The seats are built of light steel tubing, which makes them completely free from the weaving and deterioration of wicker chairs, and are covered completely by deep comfortable upholstery. The non-shatterable glass windows are equipped with silk roller shades and solid mahogany frames. The rear windows may be opened for ventilation. The cabin interior is upholstered in two tones of high-grade automobile fabric, light in shade above the belt line and slightly darker below. This combination of coloring aided by the large sky-light window in the top of the cabin gives a bright and cheerful appearance to the interior. The sky-light window also permits the pilot to see above and to the rear. Leather safety belts are provided on all seats and a heater keeps the cabin snug and warm in the coldest weather.

Teaching Elementary Aerodynamics

ONE of the most interesting educational developments of the day is the extent to which elementary aerodynamics, the science of air flow, is being taught to the youth of the nation. We would, of course, expect aerodynamics to be taught in ground and flying schools and in the universities and technical schools offering courses in aeronautical engineering, but what is remarkable is that aerodynamics is now an accepted subject in a number of secondary schools engaged in general education.

Since the science of air flow has many applications outside of aviation, as in windmills for generating power, in sailing vessels, in the determination of wind loads for buildings, in the streamlining of racing automobiles, and in the design of air fans of various descriptions, the spread of knowledge of this subject has value for the general industrial life of the nation.

While air is all pervading, it is generally invisible and therefore its laws are apt to appear mysterious. The instinct which enables us to understand mechanisms such as the wheel and the lever no longer suffices, and it is a matter of some difficulty to bring home fundamental principles to the student.

Theoretical exposition is insufficient and there must be methods available for visualizing air flow and forces. It is therefore gratifying to see a text specially devoted to "Elementary Laboratory Aerodynamics," written by Arthur L. Jordan, of the Polytechnic High School, of San Francisco, and published by the Ronald Press, New York.

This manual gives directions for laboratory experiments suitable for students of the ordinary high school, and assumes a knowledge of elementary algebra and geometry only. Apparently any wide-

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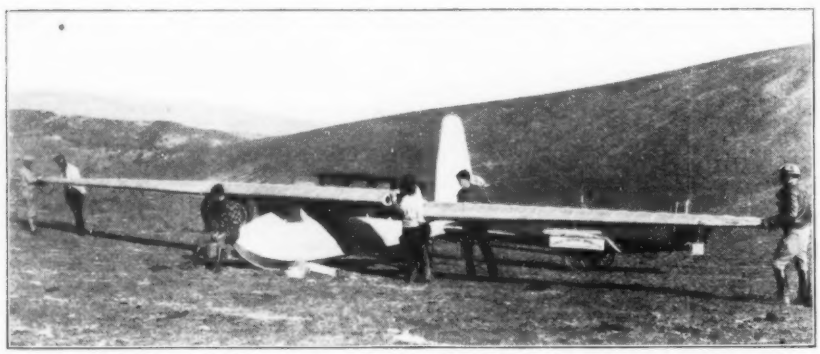
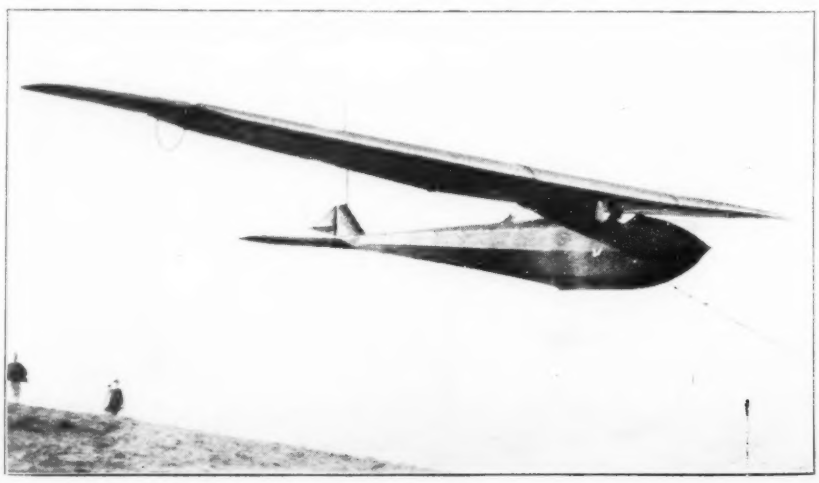


Lindbergh takes to gliding! ***Above:*** **Installing a new wing on the Bowlus sailplane glider.** ***Below:*** **The same glider just after the take-off, with Col. Lindbergh at the controls**



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An Advertisement of the American Telephone and Telegraph Company

IT HAS its home in your town. Its operators are the daughters of your neighbors. Its various departments are in the hands of your own citizens, with years of training in telephone engineering and management. Who owns the Bell System? 450,000 people scattered over the United States own the stock of the American Telephone and Telegraph Company and 250,000 own other securities of the Bell System.

No matter how small the part of the Bell System that serves you, it has behind it research, engineering and manufacture on a national scale. The Bell System operates through 24 companies, each designed to fit the particular area it serves—to furnish the highest standard of service in a manner personal to the needs of every user.

Serving each of these 24 operating companies is the staff of the American Telephone and Telegraph Company, which is constantly developing better methods of telephone communication. Each draws on the findings of the Bell Laboratories, one of the greatest institutions of its kind in the world, for the continual scientific improvement of telephone service.

Each has the benefit of the buying power and specialized manufacturing processes of the Western Electric Company, which supplies telephone apparatus of the highest quality and precision for the entire Bell System.

Each takes advantage of every improvement in practice, equipment and economy.

The Bell System's ideal is to give all of the people of this nation the kind of modern, convenient telephone service that they want, over its wires to connect them one with another and with the telephones of the rest of the world. It is your telephone company, at your service with every resource that it commands.

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Gas Industry By-Product Aids Agriculture

SULFUR, for the agricultural market, must be of finely divided particle size. For years manufacturers of spray and dusting materials have striven to produce, economically, a sulfur the particle size of which would satisfy this demand. Plant pathologists have demonstrated by careful field tests that the efficacy of sulfur is determined by its fineness—the finer the particles, the quicker the oxidation and hence the toxicity toward fungous diseases, for sulfur is primarily a fungicide; a destroyer of those innumerable plant diseases found everywhere in nature, such as mildews, scabs, and "rots."

Manufactured gas contains hydrogen sulfide gas as an impurity. This hydrogen sulfide must be removed if the gas is to be used for domestic purposes. The problem of purifying gas has engaged the energy and time of the gas industry for many years. The industry's problem was to furnish a purified gas to the American home. When, however, it was finally solved, it was realized that a definite contribution to another industry had unintentionally been made. One of the products resulting from the purification of gas was elemental sulfur recovered in an extremely fine division. Here was the product desired by the plant pathologist—sulfur with particles of colloidal dimensions, wettable, easily suspended in water or in miscible oils, and obtained in this ideal physical condition without the necessity of mechanical grinding.

An idea of the fineness of this recovered sulfur is obtained from some comparative measurements which involve commercial competitive sulfurs. Recovered sulfur has particles ranging from less than one micron (0.001 millimeter) to 15 microns. Ground roll sulfur dust particles range from 50 to 200 microns.

The essentials of the process are explained by Vincent Sauchelli, of the Koppers Company Research Laboratories, in a recent issue of *Chemical Markets*. Raw gas as it comes from the carbonization process contains hydrogen sulfide and other impurities. The gas is passed through a specially prepared chemical solution. This solution absorbs the hydrogen sulfide and is led into tanks. These tanks are equipped with submerged pipes which have many orifices through which air is forced. This aeration causes a chemical reaction which liberates elemental sulfur. The air is forced into the solution in the form of minute bubbles through the tiny orifices. These air bubbles seem to have a particular attachment for the sulfur particles liberated in the solution. As a bubble attaches itself to a sulfur particle it lifts it to the surface. The result is a neat separation and flotation of the sulfur in the form of a froth or foam. The sulfur froth may become 6 to 18 inches deep and contain from 6 to 12 percent sulfur. A sufficient air pressure is maintained in the system to force the froth to overflow into troughs. In the trough the froth subsides through the formation and release of the larger air bubbles, leaving a creamy slurry which flows into a pit or tank. The slurry is then pumped into filter presses where the sulfur is recovered as a wet cake having about 50 percent water.

Excellent results have been reported from a large number of careful tests on the agricultural value of this new product.

Gas and Holder of Blimp Both Chemical Products

THE dramatic part of chemistry in the development of aviation was stressed in a paper presented at a recent meeting of the American Electro-chemical Society. Of prime interest among the many contributions of the chemist to the art of flying is the commercial perfection of a metal known as Alclad, from which the gas bag of the *ZMC-2*, the first all-metal dirigible, is constructed. This material consists of a sheet of duralumin coated with very pure aluminum. Thus, use is made of the strength of duralumin (an alloy of aluminum, iron, silicon, copper, magnesium, and manganese) and of the superior corrosion-resisting properties of pure aluminum. The outer pure aluminum is decidedly more resistant to corrosion than the strong aluminum alloys.

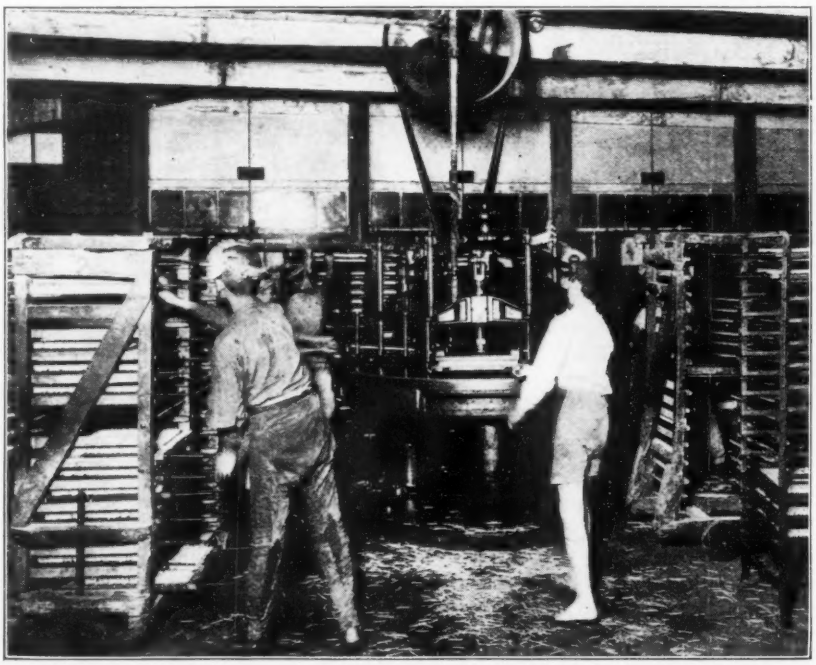
However, as Dr. Edwards and C. S. Taylor in their paper pointed out, when corrosion does occur, as for example at the exposed edges of the duplex metal sheet, it is at the expense of the protective aluminum coating and not of the alloy core. The pure aluminum is anodic to the duralumin core by as much as 0.1 to 0.2 volt, which apparently is sufficient under the circumstances to protect the core from the intergranular type of corrosion, to which certain of the heat-treated, strong aluminum alloys are subject.

The helium used in the Navy's latest "blimp," is also a product of recent chemical technology. This gas, formerly very rare and expensive, is now produced by the United States Bureau of Mines plant at Amarillo, Texas, from natural gas, where remarkable improvements in the process of manufacture have assured the Navy of adequate supplies of helium at reasonable cost. Latest figures indicate the cost to be $17.63 per thousand cubic feet of 97.7 percent pure helium. The capacity of the plant is approximately 850,000 cubic feet per month of the non-inflamable gas which supplies the "lift" for all United States Navy blimps and dirigibles.

Would Burn Coal Underground

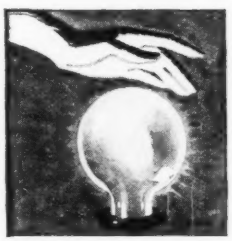
COAL mining may become a lost art if time proves the practicability of an idea of Leo Ranney, well-known in coal and oil refining circles. Mr. Ranney proposes to set fire to the coal deposits and allow the fuel to burn underground, piping the resultant gases to the surface. Patents to cover the process have been applied for.

Mr. Ranney explained that by controlling the burning coal, either petroleum or carbon dioxide may be produced. From the former, he said, gasoline can be refined;



A view taken in the chemical department of the plant of the Toyo Match Company at Kobe, Japan. Here the "heads" are put on "Made in Japan" matches at the tremendous rate of 300,000,000 dozen boxes per year. Modern machinery is used in the various processes throughout this plant

FOUND . . .



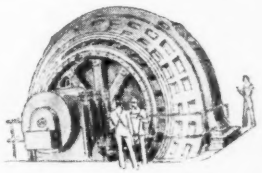
a way to improve ALADDIN'S LAMP

LESS than three years ago a row of glow tubes sat in a test rack before a window in the Westinghouse research laboratories at East Pittsburgh.

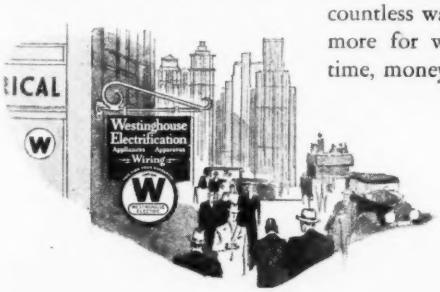
D. D. Knowles, research engineer, glanced at them one morning and noticed that some of the tubes quite unexpectedly were glowing, while others were not. Some tubes glowed when the sun was shining and went dark on cloudy days; others responded when a hand touched the glass.

It was quickly recognized that an important new electrical development had come to light. Thousands of tubes were made and tested. Shapes of various parts were altered until a relay was available—so sensitive that a tiny pulsation of energy, less than that expended by a fly walking on a window pane, was made to control enough current to operate machines rated at thousands of horsepower. Thus was born the grid-glow tube. Because of this development a hand waved lightly over a crystal ball in New York City started giant motors in the Homestead Steel mills hundreds of miles away. Aladdin's lamp, which had to be rubbed to get results, is outrivaled by the grid-glow tube which responds to a mere wave of the hand.

To magnify human capacities is the daily work of the Westinghouse organization. In research, in the design of electrical and allied equipment, in



the application of electrical power to new tasks, in the distribution of electrical apparatus for homes, business, and industry, Westinghouse is constantly active . . . to the end that electricity may continue in countless ways to help you get more for what you spend of time, money, and energy.



ELECTRIC POWER BUILDS BUYING POWER

Westinghouse

while from the latter, dry ice can be manufactured—both at low cost. It was further explained that the gas can be piped to the consuming area or burned at the mouth of the mine and used to generate electricity.

While he did not reveal the workings of his process specifically, Mr. Ranney said the first production work would start either in Illinois or Pennsylvania.

Mr. Ranney is the inventor of a system whereby oil fields abandoned as completely drained can be made to yield further through the drying of subterranean sands. These patents are owned by the Standard Oil Company of New Jersey. His latest process is said to terminate many years of experimentation in the oil industry, in attempts to control gas generated by burning coal underground.

"The World's Worst Fire"

THE photographs show successive stages in the combating of what is known as the world's worst fire—a blazing pool of highly inflamable liquid, such as oil or gasoline, into which a stream of new fuel is flowing as it burns. Of the several modern methods of fighting fire which chemists have developed in recent years, none so effectively combats a conflagration of this kind as the "blanketing" method, whereby a stream of foam is spread over the blazing liquid, shutting off its supply of oxygen.

These pictures show a demonstration of the "Foamite" system now widely used in the oil fields, in which two cans of gasoline were punctured and set afire. The last picture shows clearly how the dense foam piles up over the fire and extinguishes it, even though a stream of gasoline is still running out of the upper can.

Asphalt Emulsions Find Uses

ASPHALT, generally associated with road paving, has begun an invasion of a wide variety of manufacturing processes as a result of the discovery that this material can be used as a water emulsion. Asphalt is insoluble in water and heretofore it has been applied either by heating it until it melts or dissolving it in inflammable solvents.

When applied by heating there are fire hazards and danger to workers; also, serious impairment of the asphalt may take place as a result of careless heating. When applied by means of a solvent, there are the disadvantages of fire hazard, obnoxious fumes, inability to obtain a thick coat, and the necessity for a moisture-free surface. Emulsified asphalt overcomes these disadvantages very effectively, as shown by an article by Lester Kirschbraun in a recent issue of *Chemical and Metallurgical Engineering*.

In the emulsification operation the asphalt is dispersed in water, as exceedingly fine particles, upon which the emulsifying agent is most probably absorbed as a protective layer. The emulsifying agent may be any of a number of substances, but it has been found that the use of a selected clay-like mineral produces a dispersion satisfactory for a large variety of industrial purposes.

Unlike paints, asphalt emulsions can be made totally suspendable so that they be shipped to distant points in large drums without any danger of settling out. The material can be mixed with cement, acids, salts, other electrolytes, fibers, pigments, and so on. The application requires no heating and it is only necessary to permit the coated material to lose its water by evaporation.

Above: A demonstration of Foamite; *below*, a view of an oil fire, in the Goose Creek Texas, field

The dried coat left is irreversible—that is, it will not re-emulsify when placed in water. It will adhere to surfaces to which asphalt generally adheres, and to others such as water-wet surfaces, cement, and wood.

One of the most interesting uses of the emulsion is as a binder in mastic flooring. The emulsion, containing fiber uniformly incorporated, is mixed with Portland cement and sand. Such materials are particularly adaptable for factory floors, trucking aisles, loading platforms, ship decks, driveway patches, and railroad car floors. Due to their resiliency and toughness these floors improve as traffic rolls over them. Forty-eight hours after such floors are laid, they will take care of heavy trucking. Their maintenance and repair are accomplished with ease.

During the past few years asphalt emulsions have been incorporated with success in moistureproof and waterproof paper. As carried on commercially the emulsion is handled with the paper stock by pumps and may be introduced into the paper-making system either by admixture with fiber in the beater or at the paper machine.

A wide variety of products has already been introduced and others are being perfected. These products include floor tiles made on a wet machine; thermoplastic boards; molded products such as pails, tubs, and the like, in which a mixture of asphalt emulsion and pulp is sucked onto molds; sheathing paper; mulch paper; moisture-proof board for containers to be used for foodstuffs, soaps, and other commodities in which it is desired to minimize the effects of change of moisture content.

One of the most important uses of asphalt emulsions is as protective coatings on structural steel and on pipe lines.

Cream-Separator Principle Widely Applied in Chemistry

THE centrifugal cream separator is familiar to everyone who has ever seen a dairy, but comparatively few people realize that the same machine plays an important role in many chemical operations far removed from the farm. Not only is the centrifugal principle applied to the separation of two liquids of different specific gravities, but it is just as useful in removing suspended solids from a liquid.

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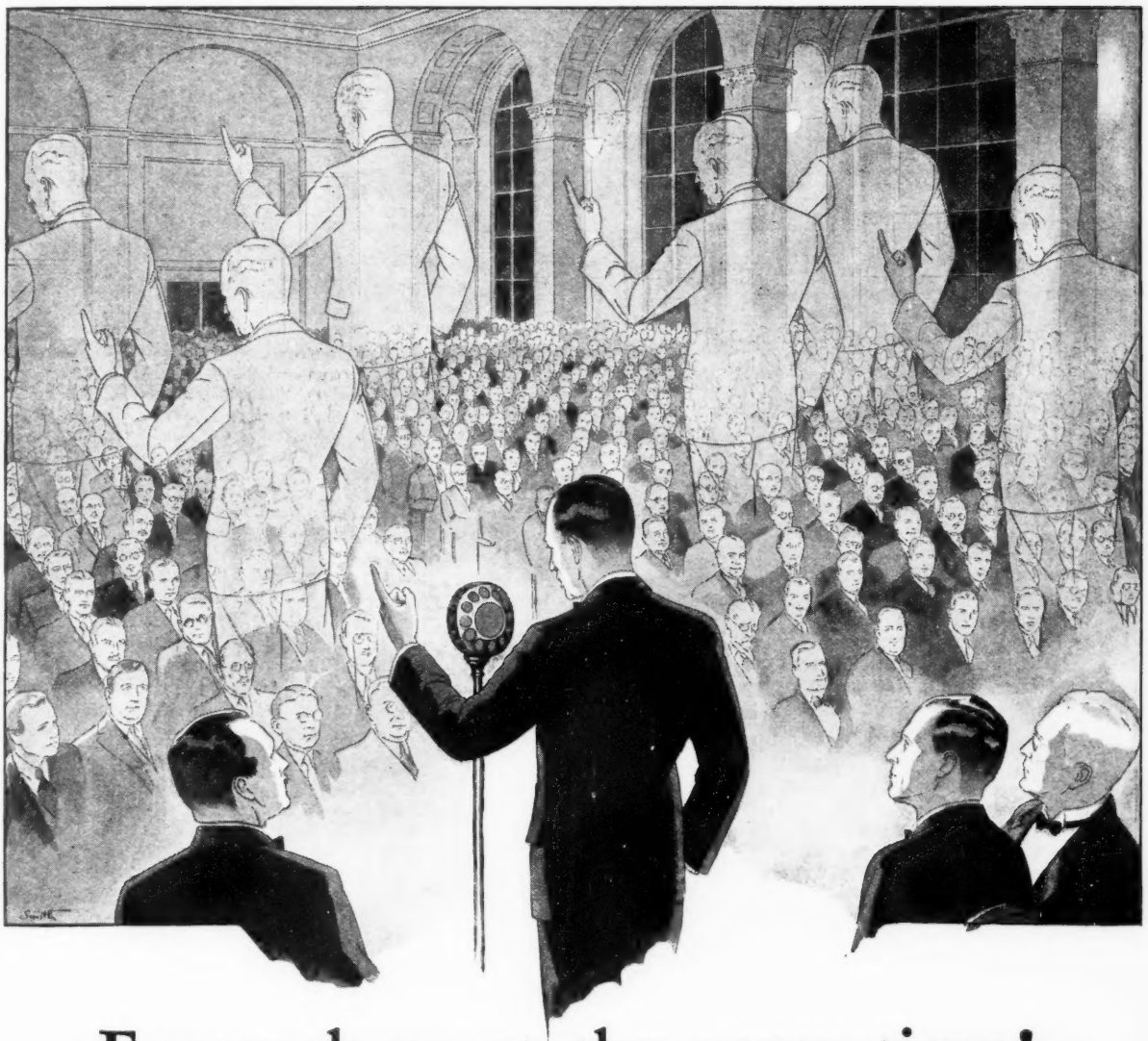
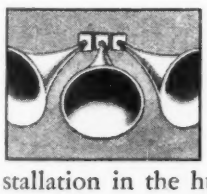


Everywhere at the same time!



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Agriculture

THE USE OF EXPLOSIVES IN BLASTING STUMPS, DEPARTMENT CIRCULAR NUMBER 191, contains 21 "dont's" for prospective blasters, with recommendations and instructions. *U. S. Department of Agriculture, Washington, D. C.—Gratis.*

THE PROGRESS OF BIOLOGICAL CONTROL OF PRICKLY-PEAR (CACTUS) IN AUSTRALIA, by Alan P. Dodd, discusses the operations of the Commonwealth Prickly-Pear Board in its efforts to control the pest. This American plant has taken possession of about 65 million acres in Australia. *Commonwealth Prickly-Pear Board, Brisbane, Queensland, Australia—Gratis.*

REINDEER GRAZING IN NORTHWEST CANADA, by A. E. and Robert T. Porsild, is a well-illustrated report of a botanical expedition of great importance. The authors covered about 15,000 miles by dog team, canoe, motor boat, pack dogs, and snowshoes. They brought back what is probably the largest single botanical collection ever made in Arctic America, many zoological specimens, and about 1000 photographs. The United States Bureau of Biological Survey and other American agencies co-operated in the investigation. *Department of the Interior, Ottawa, Canada—Gratis.*

Electricity

BELL LABORATORIES RECORD, CUMULATIVE INDEX TO VOLUMES ONE TO SEVEN INCLUSIVE, lists by authors, subjects, and titles, the numerous research papers published between September, 1925, and August, 1929, inclusive. *Bell Telephone Laboratories, Inc., 463 West Street, New York City—Gratis.*

PUBLIC SERVICE THAT PROTECTS PROPERTY AND LIVES IN THE ELECTRICAL FIELD is the title of an illustrated booklet describing the high standards insisted upon by workmen pledged to adhere to the Electrical Code. *Electrical Workers' Union No. 3, 130 East 16th Street, New York—Gratis.*

HYDRO-ELECTRIC PROGRESS IN CANADA DURING 1929, BULLETIN NUMBER 1353, contains brief descriptions of all important water-power developments under construction during 1929. Undertakings now under construction, it shows, will add more than 1,600,000 horsepower during the next three years. The total for the Dominion now is 5,727,600 horsepower. *Dominion Water Power and Reclamation Service, Ottawa, Canada—Gratis.*

LIGHTING FUSE, by F. P. Griswold, shows the best methods of doing this type of work, and describes various types of fuse lighters. This leaflet is one of the Explosives Service Bulletins which are issued from time to time to keep explosives users posted on the latest improvements in the technique of handling explosives and blasting accessories. *E. I. DuPont de Nemours and Company, Inc., Wilmington, Delaware—Gratis.*

Metals

OXWELDED CONSTRUCTION FOR MODERN PIPING SERVICES is an illustrated booklet describing the welding of steel and wrought iron piping for a wide variety of industrial applications. *Linde Air Products Company, 30 East 42d Street, New York City—Gratis.*

IN HARMONY WITH MODERN PROGRESS illustrates instances in which pressed steel can be used to advantage in manufacturing various types of goods or equipment. *Geuder, Paeschke and Frey Company, St. Paul Avenue at 15th Street, St. Paul, Minnesota—Gratis.*

PROBLEMS AND PRACTICES OF MODERN STEEL TREATING is a well-illustrated booklet containing a summary of 23 heat treatment processes used in steel production. Each process is described briefly, the treatment best suited to the need is outlined, and the types of furnaces and instruments used are shown. *Brown Instrument Company, Wayne and Roberts Avenues, Philadelphia—Gratis.*

CENTRIFUGAL CONCENTRATION: ITS THEORY, MECHANICAL DEVELOPMENT AND EXPERIMENTAL RESULTS (Technical Paper 457) reports the findings in an investigation conducted by the Bureau of Mines. Preliminary tests show the process to be a promising one, particularly for treating tailings from mills using gravity-concentration methods. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

Sanitation

MUNICIPAL SANITATION is a new monthly magazine designed to serve an important field, with the intention to promote more sightly and more healthful towns, cities, counties, and states. *Municipal Sanitation, 225 West 34th Street, New York City—One dollar a year.*

REPORT OF THE WESTCHESTER COUNTY SANITARY AND SEWER COMMISSION covers the activities of the Commission in charge of one of the country's most notable suburban expansion projects, involving the installation of some of the most modern sewage treatment plants yet constructed. *Westchester County Sanitary Sewer Commission, Court House Annex, White Plains, New York—Gratis.*

Science

HIGH SCHOOL SCIENCE LIBRARY FOR 1928-1929, by Hanor A. Webb, is a classified bibliography designed to fit budgets of various sizes. Each book of the list is described briefly. *Journal of Education, George Peabody College for Teachers, Nashville, Tennessee—10 cents.*

SERPENTS OF THE EASTERN STATES, (Bulletin No. 3, Vol. XXXII) by Raymond L. Ditmars, is a comprehensive study of the harmless and dangerous snakes in the region covered, which includes New England, parts of New York and Pennsylvania, and New Jersey. *New York Zoological Park, New York City—Gratis.*

Miscellaneous

THERMAL PROPERTIES OF PETROLEUM PRODUCTS, by C. S. Cragoe (Bureau of Standards Miscellaneous Publication Number 97), is a paper containing the results of a critical survey of existing data on this subject, a project of the American Petroleum Institute. The tables contain what appear to be the most reliable values available. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

LITERATURE OF AMERICAN SCHOOL AND COLLEGE ATHLETICS (Bulletin 24) is a bibliographical study following the Foundation's famous Bulletin 23 entitled, "American College Athletics," which revealed the professionalism prevalent in intercollegiate sports. Professor A. Carson Rayon, of Swarthmore College, is the author of Bulletin 24. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York—Both gratis.*

PHOTOGRAPHING INVISIBLE WRITING is the title of an item reprinted from the *Literary Digest*, explaining the part ultra-violet rays play in detecting the original writing on old parchment manuscripts. With this description is sent a catalog listing the latest types of ultra-violet light equipment and auxiliaries, quartz laboratory apparatus, and laboratory furnaces, for use in studying fraudulent paintings, sculptures, antiques, minerals, and other materials or objects. *Hanovia Chemical and Manufacturing Company, Chestnut Street and Railroad Avenue, Newark, New Jersey—Gratis.*

BILBY STEEL TOWER FOR TRIANGULATION, SPECIAL PUBLICATION NUMBER 158 of the U. S. Coast and Goedetic Survey, gives full descriptions of the new-type towers and other equipment and apparatus used by government engineers in making surveys. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

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I wonder if you know how important you with other Policy-holders have collectively become in the economic life of the world. You think of your life insurance as an important factor in your plans for yourself and your families but I doubt whether you yet comprehend what you are actually doing for the world at large.

I am speaking to you now as a part of the 70,000,000 people insured in all companies in the United States and Canada. I am speaking to you as part owner of the $19,000,000,000 which has actually been assembled for the protection of beneficiaries under the $110,000,000,000 of coverage which now exists. Never before in the history of the world have individuals voluntarily, privately and co-operatively pledged such a sum for mutual protection or for any purpose.

This coverage exceeds the total resources of all the banks in the United States and Canada, including savings banks, by about $34,000,000,000. It is equal to all the resources of all our Foundations and Endowments for Education and Research, multiplied many times. Our educational, medical, scientific and charitable institutions are in the hands of trustees whose powers are wisely limited by the terms of the instruments on which the trusts rest. The Trustees of these foundations seldom have any very wide discretion as to how funds under their control shall be distributed. Neither have we.

New York Life Insurance Company
BALANCE SHEET DEC. 31, 1929

ASSETS		LIABILITIES	
Real Estate Owned and First Mortgage Loans on Farms, Homes and Business Property	$593,633,002.37	Reserves—ample with future premiums and Interest to pay all insurance and annuity obligations as they become due	$1,465,664,828.22
Bonds of the United States, Other Governments, States, Cities, Counties, Public Utilities, Railroads, etc.	672,665,159.31	Dividends Payable to Policyholders in 1930	71,796,857.00
Preferred and Guaranteed Stocks	52,414,042.00	All other Liabilities	7,859,164 31
Policy Loans, Cash and Other Assets	346,991,407.36	Total Liabilities	$1,545,320,849.53
Total Funds for Policyholders' Protection	$1,665,703,611.04	General Contingency Fund	120,382,761.51
		Total	$1,665,703,611.04

Outstanding life insurance ($110,000,000,000) is the greatest trust ever created. It, too, is managed by Trustees. The Trustees are the Directors of the various companies with whom continuously sit certain familiar figures. They are Life, Death, Disability, Necessity and Old Age.

Death has heretofore been a terrible figure because life was not organized against him. Now life is so organized. Death will ultimately come to all of us. Nobody doubts that and nobody can change it. The terror of Death (I am not now considering any religious question) lies in his cruel, remorseless and uncertain stroke. In that has been his victory.

Life Insurance faces Death not as a Terror but as a fact and deals with him just as it deals with bonds or real estate mortgages.

Let me show you how vital those $110,000,000,000 are. Back of these pledged billions lie three great forces.

First—the $19,000,000,000 in cash and securities in hand;

Second—the seventy million people who have contracted, directly or indirectly, to pay future premiums;

Third—the power of compound interest.

Together they make that $110,000,000,000 the most vital and useful force in all sociology.

Now try to visualize what is coming. Outstanding Insurance will become $200,000,000,000, $300,000,000,000, possibly much more, but it will always have those three great forces, the first two correspondingly increased, behind it. Because of its peculiar relation to the weaknesses and needs of human life it is and always will be worth more than a like sum in cash. To illustrate—

Death sits with this great Board of Trustees and Death still strikes but, in your case, not as of old. Life also sits with the Board and by quickly translating individual productive power into cash it despoils Death of his old and faithful servitor, Poverty.

Disability, crueler than Death, also sits with that Board and demands and receives stipulated sums when the bread winner fails and becomes a burden.

Necessity and Old Age also sit with that Board and are covered by the underlying instruments.

All these benefits are specified in the Great Deed of Trust: the policies in force.

Some of you, most I hope, will agree when I say that Life Insurance has come to be the most important beneficial enterprise in the manifold problems of living.

My main point is that you, beginning with your individual needs and obligations, have not only minimized the terrors of Death, Disability and Old Age but you have come, as a group, to be one of the largest holders of useful securities in the world.

You are the only group that ever existed having the courage and sanity in the current problems of living to rob Death of his terrors by dealing with him as an ultimate fact.

As a group you are not capitalists, yet you have become the greatest of capitalists.

Following your impulse of self-protection you have created the greatest of all beneficial institutions.

Seeking to banish the need of charity from your own household, you have shown how the need of charity may be completely banished from every household.

DARWIN P. KINGSLEY, President.

DIVIDENDS Payable in 1930	NEW BUSINESS 1929	TOTAL RESOURCES Dec. 31, 1929	Insurance in Force Dec. 31, 1929
$71,775,000	$953,000,000	$1,665,000,000	$7,266,000,000

Branch Offices in most of the Larger Cities of the United States and Canada.

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Carbon Monoxide Poisoning

A SPECIAL committee appointed by the American Medical Association to consider the cases of poisonous gases in industry has just made its first report which covers particularly the use of carbon monoxide and its dangers. The committee consists of: H. Gideon Wells, M.D., chairman; Yandell Henderson, Ph.D.; Paul Nicholas Leech, Ph.D.; Carey P. McCord, M.D.; and L. R. Thompson, M.D. It is pointed out that poisoning by carbon monoxide gas is one of the hazards of modern life that can never be entirely eliminated because the generation of that gas is associated with the operation of automobiles and stoves, the combustion of wood, and the manufacture of many products. Whenever wood, coal, or petroleum products are burned, carbon monoxide may be a by-product. If a coal fire is lighted and the coal is too deep for air to pass easily, or if the air supply is checked in any way, carbon monoxide may be produced by taking away some oxygen from the carbon dioxide developed in the lower layers.

Manufactured gas in most cities contains about 20 percent of carbon monoxide and burning a flame near a cooking utensil or a pipe containing cold water stops the combustion at its first stage and liberates large amounts of carbon monoxide. Cooks working over stoves are sometimes affected with headaches as a result of inhaling too much carbon monoxide. This danger can be reduced by increasing the distance between the opening of the gas burner and the cooking utensil. The cooking utensil filled with cold water should be just above and not in the visible flame.

The chief source of deaths and poisoning from carbon monoxide is illuminating gas, and the prevention of such deaths must depend largely on better inspection of devices used in the handling of illuminating gas.

There have been a number of deaths, particularly in the winter months, from the carbon monoxide in automobile exhaust gas. Every year before cold weather begins drivers of cars must be warned again about starting the engine of an automobile before opening the garage doors. For a little while it is more comfortable to have the garage doors shut, but in the same little while the person becomes unconscious from inhaling carbon monoxide and unless he is discovered in time, he will die of the effects. Recent evidence indicates that even in the streets people inhale enough carbon monoxide on some occasions to make them sick. When inhaled, this gas produces headache and nausea, and no one really knows what the effect of repeated intoxication to a mild degree may be if continued over a period of years. Various attempts have been made to develop methods of preventing the exhaust of carbon monoxide from the automobile, but thus far no practically successful method has been developed.

When a person becomes a victim of carbon monoxide poisoning, the first thing to do is to give him immediate artificial respiration. He should also inhale a mixture of oxygen and carbon dioxide until his pulse and temperature are normal. He should be kept warm and prevented from making any muscular effort, because in his weakened state this may be fatal. Simple attention to the dangers that have been mentioned is bound to diminish accidents as a result of this new hazard of modern life.

Dislocations of the Neck

EVER since chiropractic took the basic idea of osteopathy and launched it as a separate science, there has been a good deal of general interest in dislocations of the bones of the spine. The actual fact of the matter is that the spinal bones are ordinarily so well held in place that any dislocation must be brought about by a considerable force.

When there is an actual dislocation of a spinal bone, the results may be exceedingly serious. In several cases described by Dr. Mitchell Langworthy before his recent death, the symptoms were exceedingly severe. A woman aged 55 fell down stairs, striking her head on the floor. Her neck became stiff and caused great pain. In her case the X-ray showed that the second vertebra in the neck had slipped forward. Her neck was straightened out by proper manipulations and held in place by sand bags put around her head while she lay quietly. She stayed in bed two weeks but had some stiffness in her neck for three months after the manipulation.

A man 33 years old was given a sudden jerk in an automobile accident. He had immediate pain and stiffness in the neck and weakness in the use of his arms. Some bones in his neck were discovered to be out of place and by proper scientific manipulation and the subsequent use of a plaster cast he recovered, although after many months he still has limitations in his neck movements.

Another type of cause of such accident was that which was responsible in the case of a boy five years old who was grabbed by a big boy about the head and shaken. The next day his parents noticed that his head was crooked and his neck stiff. An X-ray showed that the bones of his neck had been dislocated. By manipulation, the bones were thrown back in place and he had to wear a plaster cast for three weeks before it remained in place.

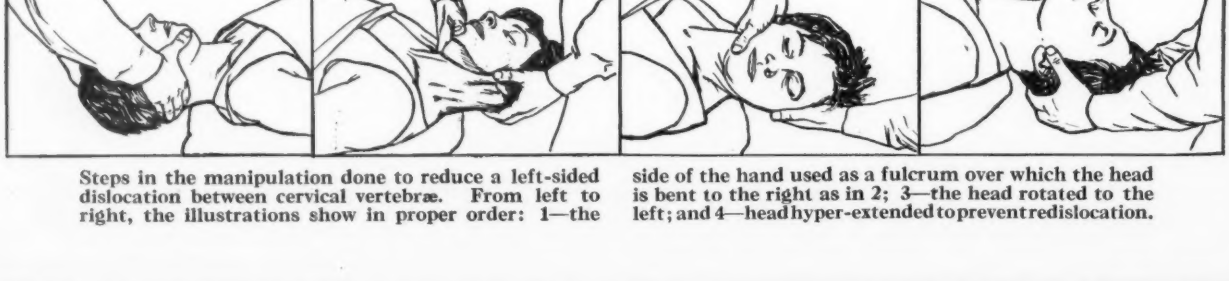
In Doctor Langworthy's discussion of the subject he illustrates the manipulations necessary to restore such dislocations in some cases, and from these pictures one can see how highly technical and serious a matter this really is.

The Gerson Diets in Tuberculosis

NEWSPAPERS have recently contained much concerning the diets developed under the famous German physician Sauerbruch and Doctor Gerson in Munich for the treatment of tuberculosis. In order to check the claims made by the German investigators, Drs. Edgar Mayer and I. Newton Kugelmass at Saranac Lake submitted 30 patients to similar methods. These were patients with far advanced tuberculosis of the lung who had previously been given all of the various special methods of treatment, but without success.

Patients with tuberculosis must be supplied with 50 calories per 1000 grams of weight, or 50 calories per day for every two pounds of weight. The diet must contain all of the important vitamins. The waste which takes place in tuberculosis tends also to rob the body of its important mineral salts, such as calcium, magnesium, potassium, phosphorus, and sulfur. The diet planned by Gerson proposes to take particular care of this demineralization and also to supply the body with the essential vitamins.

The German investigators were inclined



Steps in the manipulation done to reduce a left-sided dislocation between cervical vertebræ. From left to right, the illustrations show in proper order: 1—the side of the hand used as a fulcrum over which the head is bent to the right as in 2; 3—the head rotated to the left; and 4—head hyper-extended to prevent redislocation.

to emphasize that the Gerson diets had acid-forming qualities, whereas the controlled investigations at Saranac Lake indicated that the diet was primarily base-forming in character.

Under the Gerson diet, eight patients of the 30 gained in weight; ten showed some diminution in the quantity of sputum, and four, a lessened fever, whereas two who had not previously had fever developed it. Eight patients showed some clearing in the lungs and two with intestinal tuberculosis lost the symptoms of this complication. There was some diminution in the amount of fatigue, in the pain in the chest, and in the symptoms of tiredness.

Prof. Felix Klemperer, the well known tuberculosis expert of Berlin, is willing to grant that the Gerson diet may have a favorable effect on tuberculosis of the skin, but he has not been impressed by the results in tuberculosis of the bones and joints, and he does not feel that the method is of importance in treating tuberculosis of the lungs. His view is also supported by that of Doctor Schwalm, who is in charge of one of the largest sanatoriums for the tuberculous in Berlin. Doctor Schwalm treated 20 patients with tuberculosis of the lungs by the use of this diet, and says that in not one of the 20 did he find any noticeable improvement in the condition, and also that the increases in weight were only such as were regularly seen in the sanatorium in patients on the usual diet. His final statement is: "We have not been able to discover that the Gerson diet is superior to the diet commonly used in German sanitariums, which also takes due account of the vitamins and includes plenty of milk, fruit, and vegetables."

Phosphorus Poisoning from Roach Paste

ONCE upon a time phosphorus poisoning was fairly frequent, due to the use of this substance in the manufacture of matches. Of late, such cases are seldom seen. In most instances they are due to taking a poison prepared for animals, by a child who has not understood the danger. Doctors McLean, MacDonald, and Sullivan have reported a case of a baby 18 months old who had formed the habit, not infrequent in babies, of picking up pieces of coal, matches, or other materials lying on the floor and putting them into its mouth.

The mother had spread a thick layer of roach paste on slices of bread and pieces of potato which had been put under the ice-box in the kitchen. She noticed that two potato chips on which roach paste had been spread were missing, but did not associate their absence with the sudden symptoms that developed in the child. It had become drowsy and vomited. Its eyes became yellow. Its abdomen became distended, the wrists and ankles swelled and blood was passed both in the vomiting and in the excretions. Finally the excretions failed to flow. The baby died, and the postmortem examination indicated clearly that it had been poisoned by phosphorus. The typical changes in the liver, which had been practically destroyed through the formation of fat, were observed in this case.

The roach paste was found to contain 1.19 percent elementary phosphorus, and the container was not marked in any way to show the danger to human beings possible through its use.

You and Wire Rope

Although you may never travel by sea, ocean transportation is as necessary to your economic life as rail transportation. Yet the mammoth steel ship of today scarcely could be built without the great strength that is encompassed within the comparatively small diameter of wire rope.

Nor could the cargoes of these ocean liners be handled so quickly and economically without this flexible means of connecting power and load.

For over a half century this company has made wire rope exclusively. And in Yellow Strand Wire Rope, we believe we have attained the finest balance of strength, flexibility and resistance to wear ever developed in a rope for heavy duty. Long life and great economy are the natural result.

This company also makes all standard grades of wire rope.

B. & B. Aerial Wire Rope Tramways are an economical means of transportation under many conditions. Investigate!

Broderick & Bascom Rope Company
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Eastern Office and Warehouse: 68 Washington Street, New York, N. Y.
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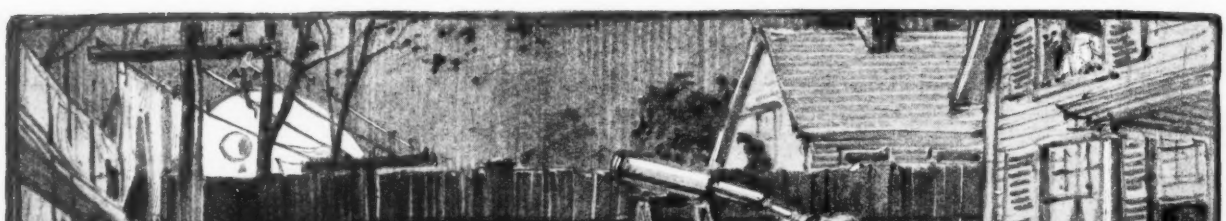
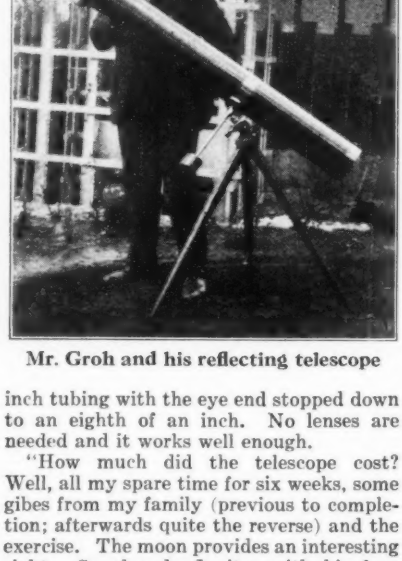


The Amateur Astronomer

"NOW that my reflecting telescope is completed," writes M. S. Groh, 33½ Thorncliffe Avenue, Toronto, "I believe my experience will be of value to others. I commenced grinding the glass (which I obtained locally) more as an experiment than anything else. The grinding progressed favorably and the elbow grease employed shortly transformed the rough surfaces into a beautiful concave of about 50-inches focal length. The development of the accurate surfaces as the grinding advanced," continues Mr. Groh who, like hundreds of other readers of this journal, has been making an astronomical telescope from practical instructions in the SCIENTIFIC AMERICAN book, "Amateur Telescope Making," "was a feature of increasing interest, perhaps more fascinating than can be appreciated by anyone who has not experienced it. This is particularly true of the final polishing and parabolizing.

"Having completed the concave mirror in good shape it did not take long to mount it temporarily and, after a few crude attempts at seeing the moon, using a small looking glass for the diagonal, I commenced to believe that the job was worth finishing. So I made a prism of ordinary plate glass, to replace the rough diagonal mirror, bringing each face of this prism flat to within a wavelength of light. Two eyepieces were made from lenses secured from a local camera repair man and these when used with the telescope gave magnifications, respectively, of 80 and 130 diameters.

"The mounting I finally made is admittedly a bit light but is satisfactory when there is no breeze to shake the telescope. It has 3½-inch dividing circles which were indexed from a 72-tooth gear-wheel. This gives me a fairly accurate line for every five degrees of declination and every 20 minutes of time in right ascension. The finder is an eight-inch length of half-inch tubing with the eye end stopped down to an eighth of an inch. No lenses are needed and it works well enough.

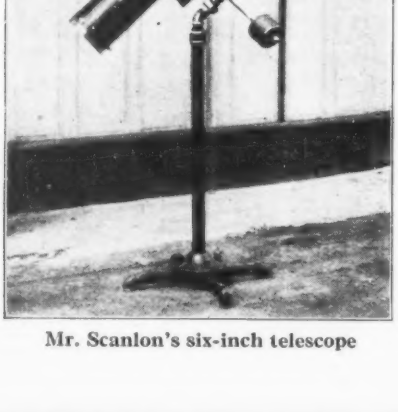


Mr. Groh and his reflecting telescope

"How much did the telescope cost? Well, all my spare time for six weeks, some gibes from my family (previous to completion; afterwards quite the reverse) and the exercise. The moon provides an interesting sight. So also do Jupiter with his four visible satellites, Venus, a number of double and other interesting types of stars, and a myriad of stars where to the naked eye there is blank nothing."

Mr. Groh requests the Telescope Editor to comment on the glass he used, that is, common plate glass. This is the kind used by all amateurs (and by professionals, too) on sizes up to 12 inches in diameter. Expensive optical glass would not serve the purpose better. For a six-inch mirror the glass disks should be three fourths of an inch thick. These disks may sometimes be secured locally, but they can be obtained from a special dealer, all put up in ready-to-begin-work form, with the correct kind of pitch and abrasives, for about ten dollars. Other parts, required several weeks later after the essential concave mirror is complete, may run the cost up to about twenty-five dollars, but the finished product should perform on a par with a 300-dollar instrument. A six-inch reflector equals a four-inch refractor in general performance.

F. L. SCARBOROUGH, 2105 Fourteenth Avenue North, Birmingham, Alabama, has made one of the telescopes of the type described by John M. Pierce, in "Amateur Telescope Making." Mr. Scarborough writes, "This simplified design was followed closely because the writer's knowledge of mountings, upon beginning the job, was negligible. There was only slight difficulty in any part of the work. My first attempt to make a polishing lap was a



Mr. Scanlon's six-inch telescope

Mr. Scarborough's tubeless telescope

failure, but on reference to 'Amateur Telescope Making' it was decided that the pitch of which the lap was made was too hard, so it was tempered slightly with turpentine and a softer lap prepared from it. Polishing with this lap was uneventful and the job was soon finished. (In the average case this takes about six hours—*Ed.*)

"Silvering by the Brashear process, as per instructions, was successful upon the first attempt. The directions for silvering were followed explicitly, using every precaution against contamination of the solutions.

"The results obtainable with this simple instrument are surprisingly good, amply repaying the slight expense, in this case about fifteen dollars which included the ready-prepared mirror outfit. The topography of the moon is strikingly clear and the effects due to changes in its phases are a wonderful sight. The planets are a delight. One view of Saturn with his rings and satellites, is generous compensation for the production of a telescope of this kind. These sights, together with others too numerous to mention, inspire one to a systematic study of science."

Mr. Scarborough's experience is typical of many others. It is perhaps difficult to believe that a raw beginner, with no more skill than is implied by the ability to do various handy jobs and with the possession of a little patience, can make an astronomical telescope that is more than a mere toy. But a six-inch mirror—the size best suited for the beginner—will magnify 100 diameters, and even at the large observatories it is seldom that more than 400 diameters magnification is used in studying planetary detail. That much magnification can be had with a 12-inch mirror which the amateur should be able to make after making first a six-inch mirror and preferably another intermediate size. Usually the beginner inclines in advance to regard the job of making the mirror as a task, but soon finds it is a real pleasure and wants to do more of it, so he makes a second and larger telescope; some have made several.

THE letterhead of Thomas F. Scanlon, 1405 East Street, N. S. Pittsburgh, Pennsylvania, gives evidence that he is a plumbing and heating contractor, but in his letter he says "I am a plumber, and I admit it." Mr. Scanlon's telescope is mounted almost entirely with various pipe fittings and plumber's accessories. This, of course, has been done before, though not so thoroughly, and this method has amply made good. These fittings are inexpensive and readily obtainable anywhere. The yoke that holds Mr. Scanlon's telescope tube was stated to be part of an old toilet tank and the retaining bands came from an old bricklayer's level. Their ends consist of brass sink bolts soldered on.

"The tube," writes Mr. Scanlon, "was made of 22-gage galvanized iron and cost one dollar fifty-six. The mirror is a six-inch and was completed during the evenings of two weeks. The eyepiece socket is part of an old wash-stand drain and some pieces of lead sink waste pipe, while the extension was made of nickeled tubing from an old wash-stand trap.

"The cell is a seven-inch perforated brass ring, a stock item in our business, having a raised seat on which the mirror rests. Three brass sink bolts were soldered radially to the circumference. These bolts fit into slots in the lower end of the tube

Facing Metal With Wood

for Manufacturing and Industry

a modern development made possible with

PLASTIC WOOD

[Reg. U. S. Pat. Off.]

Insulation of Metal — Plastic Wood is rapidly becoming a product of universal use, not only in the home, but for industrial purposes of all kinds. A most interesting application is for insulating metal surfaces against heat, cold, and electricity.

Electrical Resistivity — Tests made by an Instructor of Physics of the Massachusetts Institute of Technology show a resistivity of 10^{12} ohm centimeters, 100 times greater than mica.

Non-Conductor of Heat and Cold — When applied to metal surfaces in a thin layer, Plastic Wood will adhere indefinitely. After hardening it can be sanded, polished, painted, lacquered, varnished, or stained with oil stain to give as high a finish as any natural wood. It is, like wood, a non-conductor of heat and cold.

Weatherproof and Waterproof — Tests have been made to prove its weatherproof quality when so applied to metal. Metal slabs coated with Plastic Wood have for six months been treated by submergence under the waters of Long Island Sound and by exposure on land to sun and rain. In neither case has there been weathering or decay of the Plastic Wood, nor has it separated from the metal in any way.

Metal Boats, Cars, Furniture and Aviation — Practical working experiments are now being conducted with Plastic Wood for facing metal in numerous industries—it is being tested under actual sea conditions for decks on metal ships; it is being tested for railroad and electric cars; it is daily used in aviation for covering metal turn buckles; extensively used in automobile body manufacture; the possibilities of its use with metal furniture are under consideration.

Inquiries Invited — Manufacturers and others interested in the application of Plastic Wood for facing metal are invited to communicate with the factory. Plastic Wood is made for industrial purposes in oak, light mahogany, dark mahogany, gum wood, walnut, cedar, ebony and other selected woods, and can be supplied in any standard paint colors.

PLASTIC WOOD

(Reg. U. S. Pat. Off.)

Handles Like Putty — Hardens Into Wood

At Hardware and Paint Stores —

Tube, 25 cents; ¼ lb. can, 35 cents; 1 lb. can, $1.00

Plastic Wood Solvent, 25 cents

Special Bulk Prices to industrial users on application

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Deafness

What reading-glasses are to weak or tired eyes, a scientific electric hearing-aid is to ears that hear faintly. Sounds that seem far away are amplified and brought to the ear with satisfying volume. For occasional or regular use, the hard of hearing will find comfort and satisfaction in

PHONAK

The Articulate Hearing-Aid

PHONAK, the articulate hearing-aid, is the result of more than 12 years of development work, and employs electric principles new to hearing-aids. The result is an exact reproduction of the original sounds—words or music, without distortion—clear, quiet, natural, and with ample volume.

PHONAK agents will gladly demonstrate the different models. Then if you wish, a ten day trial in your own home can easily be arranged without cost. If there is no PHONAK Agent near you we will be glad to show and demonstrate PHONAK in our consultation rooms or arrange for trial by mail. Write The French Electric Co., Inc., George Barton French, President, 654 Madison Ave., New York, N. Y.

The Midget "Five-in-One" Slide Rule

is a combination Mannheim, Polynetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Fabrikoid Case, 50c extra. Sent C. O. D. if desired. Catalogue Free. **GILSON SLIDE RULE CO., Stuart, Florida**

(Patented 1-17-22)

"Your Eye Sees It~

250 times larger"

MADE IN U.S.A.

WOLLENSAK MICROSCOPE

$16.50

SOLVE the mysteries of insect, plant and mineral life with the Wollensak Microscope. Reveal to yourself the beauties of nature hidden from the unaided eye. One of these fine microscopes should belong to every student, dentist, physician, or scientist and should be part of the equipment of home, office, school, or laboratory. *It gives a range of magnifications from 100 to 250 diameters in steps of 25.* Elaborately finished tilting stand, nickel trim, plush lined case, prepared slide, complete instructions. Ask your dealer, or, we will send you one postpaid. *Money back guarantee.* Lower powered Wollensak models $2.50 to $8.50. Catalog free.

WOLLENSAK OPTICAL COMPANY
911 Hudson Avenue Rochester, N.Y.

and are held by wing nuts with washers. Similarly the mirror is held to the brass ring by three more sink bolts on which it rests. This perforated cell allows half an inch clear all around the mirror, permitting ventilation of the mirror at all times. (A fine idea, as it controls the temperature changes that may distort a mirror and affect its performance—*Ed.*)

"Results?" Mr. Scanlon inquires. He answers his own question, "Yea, bo!"

THIS letter shows what a wide variety of picked-up second-hand dingbats an ingenious amateur can adapt to use in a home-made telescope. Most plumbers, in our own experience, are not half so resourceful, at least on jobs you get them to do for you. This, however, may be why Mr. Scanlon, who describes himself as a plain plumber, is really a plumbing and heating contractor. Readers having a nasty disposition may wonder whether a plumber, when he is doing this kind of work for himself, ever has to "go back for his tools." How does he figure up his time, and does he charge himself any profit on it? An anxious, breathless world would like to obtain these scientific data from a brother telescope maker who is presumably on the "inside."

All telescope makers are invited to send in photographs of their completed telescopes.—*A. G. I., Tel. Ed.*

The Heavens in April

By PROF. HENRY NORRIS RUSSELL, Ph.D.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.
At 9½ o'clock: April 30.
At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

MERCURY is in conjunction behind the sun on the first and is an evening star thereafter, on and about the 27th, when he is at his greatest elongation. He should be easily observable, as he does not set until 8:30 P.M. He is then in Taurus not far from the Pleiades and appears as bright as Capella or Procyon. Venus is an evening star and is steadily growing brighter. By the end of the month she stays in sight until 8:30 P.M. and dominates the evening sky. Mars rises about 4 A.M. in the middle of the month, but is not a prominent object in the sky. Jupiter is an evening star, setting about 10:30 P.M. in the middle of the month, and is very prominent in the evening sky. Saturn is in quadrature west of the sun on the 2nd and is observable in the morning. Uranus is in conjunction with the sun on the 1st and is unobservable. Neptune comes to the meridian a little before 9 P.M. in the middle of the month and is well placed.

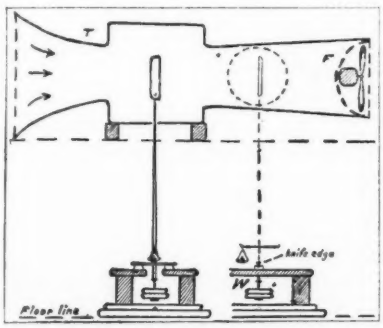
The conjunctions this month are with Jupiter on the 4th, Neptune on the 9th, Saturn on the 19th, Mars on the 25th, Uranus on the 26th, and Mercury and Venus close together on the 30th. The two planets are 2½ degrees apart and the moon passes between them.

Learning to Use Our Wings

(*Continued from page* 312)

awake physics teacher can organize a course in practical aerodynamics, if he has at his disposal a physics or mechanics laboratory and a shop with carpenters' and mechanics' tools and supplies.

A small demonstration wind tunnel can be built so that it will fit on any good-sized lecture table. The cones can be made of thin wood strips, with wood barrel hoops on the outside. The exit cone is built to fit any electric fan available. A



A small wind tunnel, from "Elementary Laboratory Aerodynamics"

hinged door on one side of the channel, and a large sheet of window glass are desirable. A rough balance of the type shown in our diagram can be readily constructed. With a little ingenuity students can make measurements of lift and drag on wings and other surfaces. Airflow lines can be made visible by smoke-screens and by very fine silk threads.

Mr. Jordan lists an imposing number of experiments which can be performed simply: measurement of lift and drag; tests of longitudinal stability; tests of directional stability, et cetera. His manual will be invaluable both to teachers and to students of the subject.

Passenger Rate Reduction

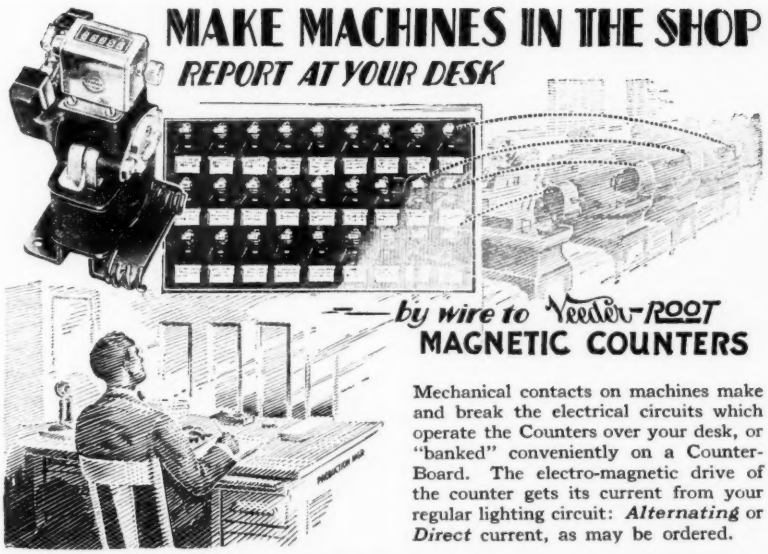
THE Transcontinental Air Transport-Maddux Air Lines have recently reduced their transcontinental passenger rates until they are no higher than those of rail and Pullman travel.

It had been previously believed in the industry that rates were not of as much importance as were the questions of safety and reliability. Yet in the week following the reduction in rates, the number of passengers increased in most surprising fashion and 222 revenue passengers were carried over some portions of the line. Forty-six of these were through-passengers, moving from coast to coast. These figures would appear to indicate that travelers have been waiting for more favorable rates.

Ice and Snow Landings

A FLYING boat can apparently take off from ice or snow. The ice was delaying tests of an Eastman flying boat, but it was found that the metal hull skidded along the ice so easily that it got off in about one half the time used in taking off from water. Subsequently the boat landed on the Grosse Ile Airport in about three feet of snow.

The event has some importance from the point of view of general adaptability of the flying boat.



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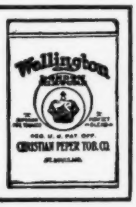

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Chemistry in Industry

(*Continued from page* 316)

The increasing applications of the centrifugal separator in industry is partially due to the improvement of the machine from its early state in which it developed a centrifugal force of only a few hundred times the force of gravity, to a model which produces a force 15,000 times that of gravity. E. M. James describes some of the applications of centrifugal separation in a recent issue of *Chemical Markets*.

In printing the color designs on leather, a paste or gum is used to hold the color and prevent it from running. The paste is mixed with the color and applied to the leather from copper rolls. It is extracted from certain species of shrubs, and in a crude form is likely to contain woody fibers. If these shreds of wood are not removed from the paste, the dye would show in streaks and the copper rolls might be blemished. Such a product would be difficult to filter, but is easily clarified with the centrifuge. The centrifuge discharges continuously a clarified paste, removing dirt, sand, and shreds of wood.

Centrifuges are used for the clarification of fuel oil used in the manufacture of glass bottles. Uncentrifuged oil contains a small percentage of tiny black particles. When the oil is burned such particles form incandescent "sparks" which fly into the glass, causing defects in the bottle. These particles are removed by a simple process of centrifuging.

The clarification of baking enamels used by manufacturers of automobile bodies is being handled very successfully by centrifuges. The body parts are dipped, and any dust and other speck-forming particles would contaminate the paint. The used enamel from the dipping vat is reconditioned by the centrifuge, coarse foreign material being removed without disturbing the pigment. The process has invariably resulted in a reduced cost for a smooth, brilliant finish. In a typical plant but one half of the labor formerly required in rubbing is needed as the surface dries with a smooth finish.

The presence of small amounts of water and impurities greatly accelerates the deterioration of fatty oils. The result is the production of free fatty acids with consequent unpleasant flavor. This is often accompanied by undesirable bacterial action. The dehydration of butter oil is typical. Butter oil containing over 0.11 percent moisture does not keep well unless preserved. Butter oil separated from butter or cream oil and dehydrated with the centrifuge may be sealed in cans and kept indefinitely without deteriorating.

The clarification of lubricating oils for all types of machinery—Diesels, compressors, turbines, and machine tools—provides one of the most wide-spread and profitable uses of centrifuges.

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LIGHT-WEIGHT concrete, made without sand or stone, is one of the latest achievements of chemists in the field of construction materials which has resulted in the production of a pre-cast slab for roof construction now on the market. The new slabs are said to weigh only about two thirds as much as similar slabs made from sand concrete. At the same time, the thermal conductivity is only about 37 percent that of sand concrete.

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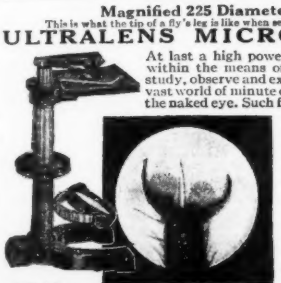

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Minute Impurity Explains Riddle of Photographic Film

AMATEUR photographers, and professionals also for that matter, little realize the tremendous amount of involved chemical research that enables them to take a picture by merely pressing a button. The writer spent two years in the manufacture of photographic film, a sufficient experience to convince him that for pure cussedness and unexpected vagaries, there is nothing in chemistry to beat the behavior of photographic emulsions.

Photographic film consists of two layers, a thin translucent film containing a suspension of light-sensitive silver salts in gelatin, and a thicker transparent layer made either of cellulose nitrate or cellulose acetate. The light-sensitive layer is called the emulsion; the lower layer, the film base or support. It is in the making of the emulsion that the chemist finds his patience most sorely tried, partly because of minute variations in the quality of the ingredients and partly because the field is so fascinating that its exploration seems tediously slow. For example, one problem of practical as well as theoretical interest is the work done by Dr. S. E. Sheppard and his collaborators on the isolation of the sensitizing substances in photographic gelatin, described recently by G. E. Matthews in *Chemical Markets*.

For many years emulsion makers have known that certain gelatins were satisfactory and others were unsatisfactory for photographic use. Several years ago it was found that an extract could be prepared from a good gelatin which, on addition to a relatively inert gelatin, made it photographically active. An extensive investigation was then begun during which the entire process of gelatin manufacture was subjected to a thorough analysis. Hides, bones, cereal preparations, and many other substances were examined. Finally it was shown conclusively that a derivative of mustard oil, called allyl thiocarbamide, was the sensitizing substance. Its presence in minute concentrations of one part in 1,000,000 to one part in 300,000 was shown to be the cause of the suitability of certain gelatins for use in photographic emulsions.

During the emulsion making process, this substance is converted over by a series of reactions into silver sulfide which was shown to be present as small specks or nuclei and proved to be necessary in order that the grains could be developed.

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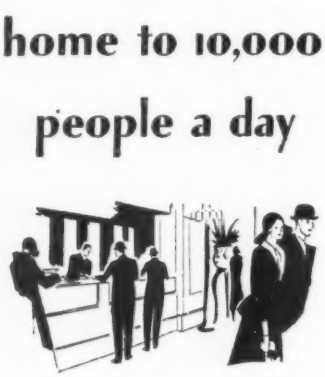

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Our Point of View

Naval Conference Problems

(Continued from page 269)

Japan struck a discordant note by her insistence on a 10:7 instead of a 5:3 ratio in cruisers; according to the press, the Japanese delegation was reminded that any change in the 5:3 ratio would reopen the whole problem of fortified bases in the Far East as settled at the Washington Conference. As Japan is aware she was the real beneficiary of that treaty she probably will not press the point. With an army second only to the French, Japan will have difficulty in convincing the rest of the world that she is entitled to increase her naval force particularly at a time when she has difficulty in balancing her budget, and is already militarily predominant in the Far East.

ITALY has been tenaciously clinging to her claim for a parity with any other continental European State, meaning France. The informed claim that Italy would not build up to France even if she were accorded the right—that Mussolini's representatives are only engaged in a contest for prestige. France bitterly opposes any such recognition of Italy; and some say France is prepared to prevent any such agreement even if it involves breaking up the Conference.

Mr. Stimson has made a brave effort to find a satisfactory meeting ground for France and Italy by having the Conference formally recognize the right of any state to create any size army or navy it wishes, and then agree that for five or six years the five contracting powers will not exceed certain ratios in the various classes of ships. This is a constructive idea and will not only assist France and Italy to settle their present difficulties but will formally recognize that agreements reached in 1930 are not expected to bind in perpetuity the naval forces of five great and growing states, whose future naval needs can be only dimly discerned at present.

To date the most concrete proposal is that made by Mr. Stimson and apparently accepted by Great Britain; the part concerning cruisers contains a clause permitting sufficient adjustment between 6-inch and 8-inch gun classes to meet the needs of both states.

The following table indicates an approximate solution under the Stimson-MacDonald formula:

1			2			3		
UNITED STATES			GREAT BRITAIN			JAPAN		
No.	Cal., Guns	Displacement	No.	Cal., Guns	Displacement	No.	Cal., Guns	Displacement
10	6″	70,500	35	6″	193,000	21	5.5″	99,000
18	8″	180,000	15	8″	146,000	8	8″	68,000
11	6″	77,000				4	3″	40,000
39		327,500	50		339,000	33		207,000

Columns 1 and 2 show the probable result to United States and British cruisers if Mr. Stimson's plan is accepted. If Japan's contention for 70 percent instead of 60 percent of cruiser strength is granted, it would increase her cruiser tonnage to 238,000 tons which, if devoted entirely to

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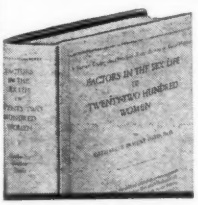
By KATHARINE BEMENT DAVIS, Ph.D.



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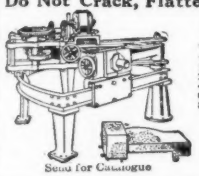

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8-inch-gun cruisers, could add 3 to her 12, giving her 15 8-inch-gun cruisers, a parity with Great Britain in that class. Australia and New Zealand are reported to object strenuously to a parity between Great Britain and Japan in this class of vessels, and it is no secret that our delegation is opposed to any increase of Japan's ratio.

The proposal to reduce capital ships to 15-15-9 by scrapping five British, three American, and one Japanese capital ships seems to meet general approval. This is a dangerous reduction for powers like the United States and Great Britain—whose fighting strength is practically limited to their fleets—for their armies are negligible compared to the conscript hosts of France, Japan, and Italy. The United States, in particular, would do well to resist the temptation to abolish the capital ship that still dominates the ocean routes and gives to a country possessing only naval power, some counterpoise to the land-powers of states with great armies.

France has good reasons for resisting the abolition of the submarine, which is the natural weapon of a weaker naval power; and it will not become us to oppose the French use of the submarine, for when our surface fleet was relatively weak we relied in large measure on the submarine as a balance. The improper use of submarines by one state during one war should not prevent the legitimate employment of an effective weapon of war. It is a curious fact that no one advocates the abolition of aircraft, yet everyone knows that, in the next war, more non-combatants will be killed by bombs from aircraft than by torpedoes from submarines.

THE American delegates have justified the country's faith in their abilities and so far have accurately reflected its desire for security and world accord. When the results of the Conference are ratified by the Senate it will remain for Congress to provide the necessary funds to carry out the modified program, and if the sum required to bring our navy up to parity seems large, we must remember that between 1922 and 1928, in modern cruisers alone, England laid down or appropriated for 162,000 tons, Japan 128,000 tons, while we constructed only 80,000 tons. We have already taken our cruiser holiday and we will soon be called upon to spend proportionately more than England or Japan, because our first plan of leading the naval powers to "cruiser disarmament by example" failed. It was an inspiring idea but the world was not then ready for disarmament by example.

Also, if our delegation obtains the right to construct one new battleship to balance the British *Hood*, we should improve the opportunity, for despite the newer weapons, the battleship is still the backbone of the fleet. In the years immediately following the World War, the question of national defense was considered from all viewpoints by the American Congress; many believed in an immense army raised by universal service, but finally in response to an overwhelming public opinion, the old system of a small, highly trained Regular Army, backed by the National Guard and Reserves was re-adopted. To shield the country while our miniature army expands, a fleet capable of meeting and defeating an enemy fleet on the high seas is necessary; and only to a fleet containing its full share of post-war battleships can such a tremendous responsibility be safely confided.

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SEPULCHERED in the great mosque at Damascus, this Saracen king will ever be associated with the land which he considered as sacred and defended as aggressively as did the Crusaders who temporarily wrested it from him. Chivalry did not develop a more interesting character than this Kurd who one moment was fiercely brutal, and the next surpassed his foes by his consistent idealism. $3.65 net

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Trademarks in Latin-America

WITH the growth of trade between the United States and the Latin-American countries, it has become necessary to consider carefully the question of obtaining foreign trademark registrations. These registrations must be secured to prevent the loss of trademarks in all countries where the laws for the acquisition of legal rights to trademarks are based on registrations.

Many trademarks which are the property of merchants in the United States have been lost abroad because our merchants have been educated under the registration laws of the United States, which make it necessary to use the trademark before filing the application for registration. In the Latin-American republics, and in some other countries, this is not the case, and when this United States practice is followed abroad unfortunate results often occur. In Latin-America, priority rights to a trademark are only acquired by filing a formal application for registration.

Inasmuch as the trademark must be registered in each country where the trademark is to be protected, an agreement was signed at a convention in 1910 which made it possible to register a trademark at a central office which would send abstracts of the mark to the registration offices of the countries which were members of the Convention. Unfortunately, many of the Latin American countries did not join this 1910 Convention, and many of the countries which did join subsequently withdrew.

To avoid objectionable provisions in the 1910 Convention, which were the reasons for these withdrawals, a new Convention was signed in 1923. This Convention has been ratified by the United States, Brazil, Cuba, Haiti, Paraguay, Dominican Republic, and Guatemala. Under the 1923 Convention, a trademark registered in the Patent Office at Washington may be registered at the Havana Convention Bureau by paying a registration fee. This registration in the Havana Bureau may be extended to the Latin-American countries which have ratified the Convention, by paying the customary fees.

Temperature Indicating Device Patent Sustained

ALTHOUGH Harrison H. Boyce was not the first to conceive of a trouble indicator for use in the daily run of an automobile, nor was he the first to conceive of the specific means which he describes in his patent, he was the first to apply those specific means to that particular purpose. In doing so, he performed an inventive act. This decision was made recently by the District Court for the Eastern District of New York in the case of Harrison H. Boyce and The Motometer Company, Inc., *versus* Taft-Buick Corporation.

The court ruled that the Boyce patent, Number 1206783, was not anticipated by the prior use of a thermometer as a guide to better engineering practice in the construction of the radiator or engine of the automobile. This patent was found to be valid and infringed.

However, the two claims in suit of the Boyce patent Number 1275654 were held to be so broadly drawn as to be anticipated by the Fowler patent Number 1159918. The patent granted to Fowler was for a thermometer on the dashboard of the automobile in view of the driver, whereas the Boyce patent shows a thermometer on the radiator. The Boyce application was filed prior to that of Fowler, but it was held that Fowler was the first to conceive the invention. These two claims therefore were held anticipated and invalid.

Trademark Denied for Laundry Service

A PRINT which identifies a laundry service is not registerable as a trademark, according to a recent decision of the Patent Office, because it does not "identify an article of manufacture." Dinks L. Parrish's Laundry Corporation had sought registry for an identification print. This application was denied by the examiner, whereupon the applicant appealed to the Commissioner of Patents. The decision of the examiner was sustained.

Wanted: More Co-operation to Develop and Market Inventions

IN a communication to the editor of the *New York Times*, which was published recently in that paper, Joseph J. O'Brien made a number of pertinent comments on the subject of "Patents and Progress." Discussing the proportion of profitable patents, Mr. O'Brien says, "About 25 percent of all patents are assigned before their issue, thus indicating that the ratio of patents regarded as having financial value is very large. This is a higher percentage of success than general business ventures can claim."

Pointing out that most instances in which a patentee fails to achieve success are due simply to a lack of merit in his invention, Mr. O'Brien shows also that no highly successful inventor can claim that he has never made any patent failures. Thomas A. Edison has a larger list of patent failures to his credit than any other man in the country, just as he has achieved more success than most inventors. Henry Ford, Mr. O'Brien points out, probably has the highest percentage of commercially successful patents to his credit, covering his own inventions. His patents are practically coextensive with the devices or improvements he has embodied in his motor cars.

"All industrial progress rests on patented inventions, covered by either expired or active patents," Mr. O'Brien declares. "Only the investment trusts and banks listed on the Stock Exchange can fairly be said to be outside of the direct influence of patents. But even these base their investments in concerns partly or wholly controlled by patented inventions.

"It is difficult to get accurate information on the successes which inventors achieve. Within a brief period the press announced the death of three inventors who had become millionaires: Higgins of Brooklyn, who made his start with a patented ink bottle; Hartshorn, who gave us the spring shade roller, and Conrad Hubert, who invented the electric flash lamp and empowered the Coolidge board to dispose of 6,000,000 dollars. Oscar Hammerstein made 10,000,000 dollars from his patented cigar-making tables."

The *Times* contributor states also that it should be comprehended that practically every foundation invention in this country was the product of a so-called garret inventor. He believes that many of the practical discoveries of science are lost because accurate working knowledge of them is not properly diffused, and that engineering is usually more than a decade behind successful invention. As a means to effect closer co-operation between inventors, engineers, investors, and organized industry, Mr. O'Brien urges more study of the problems faced by the individual inventor in his struggle to carry on pioneer work. Attention also should be given to the need for a modernized system of co-operation between banking interests and inventors.

In conclusion, Mr. O'Brien says, "Much of the waste by inventors could be avoided by the application of better engineering knowledge and co-operation. Much of the loss due to delayed progress could be avoided by a policy of human understanding and beneficial co-operation with inventors. A large part of all patents filed should never be allowed to mature in formal grants, and would not if their applicants had fuller information. But many inventions now suppressed would be released for development if society would properly recognize its duty to inventors."

Edison's Goldenrod and Other Rubber Producing Plants

COMMENTING on a recent press announcement that Thomas A. Edison expects soon to supply rubber from the goldenrod plant, *Solidago virgaura*, at 16 cents a pound, *India Rubber World* presents the opinion of one of Mr. Edison's aides, who refutes the statement that any price estimate has been made on the rubber from this or other plants with which the great inventor is experimenting. Newspapers have led their readers to expect too much of Mr. Edison, apparently not realizing the difficulties which beset research in that direction.

"Mr. Edison said some time ago that he sought not so much a product to compete with commercial rubber as a material of which the nation might quickly avail itself

in ample quantity were the rubber supply endangered by war or natural disaster," according to the editor of *India Rubber World*. "As to the latter, recent experience with the Mediterranean fruit fly in Florida reminds us of what can happen. A generation ago a blight so devastated the Far East coffee lands that their disheartened owners abandoned coffee and sought solace and found profit in rubber growing; and although history may not soon repeat itself, it is well to be vigilant. In brief, Mr. Edison's main and laudable object is one of national preparedness. It is possible that goldenrod, long a bane of hay-fever victims, may one day prove a boon to the country.

"While much is heard about one plant's possibilities, the potential usefulness of other promising rubber-yielding growths being intensively studied on American soil by government, industrial, and educational agencies is almost overlooked. Little is said about *Crytostegia grandiflora*, the milkweed varieties, *Asclepias subulata*, the rabbit bush, *Chrysothamnus nauseosus*, and many other plants that are known to possess rubber-producing possibilities.

"The outstanding American success is, of course, guayule, *Parthenium argentatum*, developed with great pains and expense from a wild southwestern shrub into a domesticated plant, grown commercially as far north as latitude 39, which can be cultivated and harvested as a stable crop. Its rubber content has been so increased and the extraction process so improved that the product can vie in price and quality with some of the best grades from foreign sources."

Solving Britain's Patent Problems

BRICKBATS by the dozen have been hurled recently at the British patent system by proponents of reforms of one kind or another. In England, as in this country, the chief "fault" of the Patent Office is that it is over-worked. However, it is reasonable to assume that an institution as old as the British patent system might profit by a housecleaning now and again.

Of the numerous abuses of the system, two of the most objectionable are the intertwined facts that there are too many worthless patents, many of them invalid, and that the cost of patent litigation is in effect discriminatory. *Nature*, England's leading scientific journal, editorially takes the stand advocated by Dr. Levinstein in a recent address before the Bristol section of the Society of Chemical Industry. He urged that the validity of patents be settled administratively before the patent is issued, or after the lapse of a given interval. Considering the expense involved in patent litigation before the High Court and the Lords of Appeal, exception is taken to the alternative proposed by the British Science Guild—that the Comptroller should be empowered to try infringement actions by consent of the parties. This course is held to offer no real solution, because either of the parties could insist on carrying the case to the High Court, perhaps with ruinous consequences to the opposing party.

"I am convinced," says Dr. Levinstein, "that the time to determine the state of common knowledge is before the grant of a patent, not years later: the place the Patent Office, not the Law Courts."

Upholding this view, *Nature* cites the fact that "every patent agent and every examiner in the Patent Office construes hundreds of specifications in the course of a year. The number of documents relating to his special industry which he construes, and his familiarity with the technical details of that industry, far exceed the equipment in these respects of a High Court judge, who may never have turned his attention to the subject until it is explained to him by expert witnesses. The issue is one which requires technical understanding rather than profound legal knowledge."

Nature shows also the handicap under which the Court sometimes labors in determining the status of "subject matter" in a patent case. "The problem is stated by asking whether a skilled workman, possessed of the knowledge which was common at the date of a given invention, could have devised the latter without exercising ingenuity. . . . The Court has to ascertain what might have been done a long time ago by a fictitious workman, in circumstances which never occurred, with the aid of an abstraction called 'common knowledge' the limits of which nobody can any longer remember, and subject to an undefined quantitative restriction which is erroneously apprehended as being qualitative."

As an example of the uncertain and conflicting decisions which result in such instances, *Nature* cites the case of Bonnard *vs* L.G.O.C. In this case, the three judges of the Appeal Court were just as unanimous in attributing ingenuity to the invention as the five Law Lords were in denying it. It is suggested that such issues might be settled more inexpensively by the toss of a coin, and that no great injustice would result if the decision were made before the sealing of the patent. More seriously, *Nature* contends that administrative settlement of the issue would be particularly suitable if present standards of "subject matter" were to be raised, and if inventions which did not reach the new standard could be made the subject of short-term patents. The Report of the British Science Guild (see page 460, November 1929 issue, SCIENTIFIC AMERICAN) recommended the inclusion of short-term patents in the British system.

Patents Recently Issued

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Pertaining to Aeronautics

AIRPLANE CONSTRUCTION—A wing construction composed of transversly disposed sets of strips spaced fore and aft, functioning as a supporting and lifting surface to allow of vertical as well as gliding descent, thereby eliminating the use of the usual ailerons. Patent 1743020. Thoralf Borgan.

APPARATUS TO FACILITATE AERONAVIGATION—Whereby a sighting means mounted for oscillation, and a recording device including a stylus, will supply the pilot with the necessary data to enable him to calculate his position when flying over a partially or wholly obscured area. Patent 1742355. Adirio O. Jessen.

PARACHUTE—Having a dilatable vent or aperture at its apex, so formed that when the air first enters the vent will be comparatively small to avoid the escape of air, assuming its proper shape as the cap becomes distended. Patent 1743951. Luigi Avorio.

Pertaining to Apparel

SUPPLEMENTARY OUTSOLE FOR BOOTS AND SHOES—Which may be readily applied by an unskilled person to worn boots or shoes to repair them for future use, or for preserving outsoles when worn in wet weather, or over rough roads. Patent 1744003. Edward Gallagher.

DETACHABLE SHOE HEEL—Which will permit the substitution of a new heel for one unduly worn or damaged, also the application of heels of various heights to the same shoes, for either walking or dress purposes. Patent 1743543. Manuel S. Gutierrez.

Chemical Processes

TITANIUM OXIDE AND PROCESS OF PRODUCING SAME—The process of producing pure dioxide of titanium from reactive titanium nitride TI_2N_2 which comprises heating the same in the presence of sulphuric acid and sodium nitrate, may be used as a basis for pigments, or starting material for other compounds. Patent 1742674. Foord von Bichowsky.

Designs

DESIGN FOR A DRESS—Patent 80279. Dorothy Long.

DESIGN FOR A COAT—Patent 80280. Dorothy Long.

DESIGN FOR LEATHER OR SIMILAR ARTICLES—Patent 80320. Frederick A. Kolb.

DESIGN FOR A WALL PLATE FOR ELECTRIC BUTTON—Patent 80335. Etta M. Squires.

DESIGN FOR A SPECTACLE FRAME—Patent 80311. Dorothy S. Helm.

DESIGN FOR A COAT—The inventor has been granted two patents, 80382 and 80383. Dorothy Long.

DESIGN FOR A COAT — Patent 80422. Dorothy Long.

Electrical Devices

TELEGRAPH TRANSMITTER—Which is simple in construction, having novel means for adjusting the weight for decreasing the friction during action, thus obviating the possibility of loose connections, and means whereby the various parts may be reversed to change the device from a right-hand to a left-hand operating transmitter. The inventor has been granted two patents, 1642296 and 1742297. John R. Youngblood.

SAFETY FUSE PLUG AND RECEPTACLE THEREFOR—Having terminal means in the form of keys projecting from the plug, and passing irregular openings, thus preventing the insertion of nondescript articles for bridging the contacts, and blowing out the main fuse of the installation. Patent 1743016. Emil de Bruijn.

FLASH LIGHT—Including within a single casing a plurality of batteries and illuminating bulbs with separate controls, whereby they may be separately energized for forward or rearward illumination on a bicycle or other vehicle. Patent 1743936. Ernest Segesser.

SPARK-PLUG TESTER—For testing plugs under substantially the same degree of compression they are subjected to in practice, whereby defects will be indicated which ordinarily would not show up when the plug is not under compression. Patent 1743881. Carman S. Cole.

DIAL CONTROL—Adapted for use in conjunction with radio condensers, indicating through what revolution the plates are moving at any time, and providing the direct reading of wave lengths or frequencies in conjunction with the revolution. Patent 1743927. Otto H. Luther.

ELECTRICAL HAIR TRIMMING AND SINGEING INSTRUMENT—Which includes a comb and an electrically heated singeing element, whereby the trimming of the hair by singeing the ends may be accomplished by moving the comb therethrough thus insuring a uniform finish without danger. Patent 1744525. Samuel O. Chase.

Of Interest to Farmers

HARVESTING MACHINE—A combined harvester and shocker wherein the cut stalks are formed into shocks which are deposited on the ground in an out-of-the-way position to permit the machine to operate on the next row without interference. Patent 1743013. Theodore A. Boor.

MILK STRAINER—Wherein the filtering elements are disposed in such manner that the liquid will impinge against the side walls thus preventing clogging and forcing therethrough material desired to be strained out, the parts may be readily cleansed. Patent 1742964. Hugh F. McNally.

INCUBATOR—Comprising a casing having fresh air openings, a water pan, electric heating apparatus, and revoluble egg cabinets which make absolutely certain a thorough circulation of heated and vaporized air through the entire cabinet. Patent 1742954. Avila C. Gillette.

PEANUT-THRASHING MACHINE—Which shreds the vines so that a loosening of the peanuts is obtained, a screen providing a rough separation, both the peanuts and the chaff being subjected to a final airblast for separation before delivery. Patent 1744906. Carl R. Livermon.

CULTIVATOR—Comprising a main beam, and an auxiliary beam pivotally secured thereto, adapted to cultivate two rows at a time, and novel means for giving a fine adjustment for positioning the shovels to suit the rows. Patent 1739508. Elbert H. and George W. Fincher.

Of General Interest

EARRING GUARD—For preventing the loss of valuable earrings, particularly the type attached to the ear lobe merely by clamping means instead of passing through a perforation in the lobe, the device is inconspicuous, being concealed behind the ear. Patent 1743006. Percival C. Prescott-Richardson.

METAL CLIP—Which may be used for numerous purposes, such as closing bags and the like, and also fastening together sheets of paper, cardboard, etc., the clip will serve effectively as a reusable fastener. Patent 1742989. John Fritz.

EGG BEATER—Having shanks removably secured to the body portion for permitting easy cleaning of the shanks and the beater without placing the body portion in water. The device may be readily packed in a small space. Patent 1742230. Porter K. Bushnell.

BEAM AND COLUMN CONNECTION—As used in structural steel work, whereby practically all the riveting may be done in the shop rather than on the field, completing of the connections requiring but a few rivets, whereby a great economy is effected. Patent 1744600. Albert J. Wilcox.

MOISTENING DEVICE—Comprising a liquid container and a rotable moistening member exposing freshly moistened portions of its periphery, for facilitating the handling and counting of money, checks and the like. Patent 1742548. Joseph H. Leal.

SPRING COVER—Particularly adapted for screwing on the threaded neck of a collapsible tube, the cover instantly returning to the mouth of the tube as soon as a lever is released, thus sealing the tube contents. Patent 1743293. George W. Toft.

ROAD SIGN—Particularly adapted for warning motorists of danger either from curves or other reasons, at night, the device will warn approaching drivers on both sides of the curve when hidden from one another's view. Patent 1743317. William A. Cannon and Howard J. Hall.

AWNING—Of the marquee type, including a top sheet or roof, a valance, and a collapsible frame, which permits the awning to be extended, the frame and canvas compactly folding against the building when desired. Patent 1744563. Earl Martin.

SAFETY RAZOR BLADE-HONING DEVICE—A small device including a casing especially designed for honing the blades of Auto-Strop Razors, the blade being honed without removal from the razor, thus preventing the possibility of cutting the hands. Patent 1744752. Ernest L. Crespo.

VISIBLE CARD INDEX—Comprising a guide and a card formed of two interconnected parts adapted to be inserted on the guide with one part beneath the guide and the other partly underlying and partly overlying the guide. Patent 1745262. Luigi Lombardini.

METHOD OF DECORATING WALLS—Whereby a multi-colored liquid film, and an absorbent plastic coating through which the liquid may penetrate, may be applied to wall-forming elements such as wall board or plaster board prior to its erection. Patent 1742332. Robert I. Vincent.

HOLDER FOR ACCOUNTING SYSTEMS—Particularly adapted for account-keeping of newspaper and periodical subscribers, wherein the accounts are rapidly available, yet effectively protected, always posted up-to-date, preventing errors and facilitating making reports to the main office. Patent 1742993. Carl A. Jettinger.

PILING FOR SUBAQUEOUS CONSTRUCTIONS—In the form of hollow metallic units having U-shaped members which will interlock and may be readily assembled to produce a rigid concrete-filled barrier possessing a maximum of strength from a minimum amount of material. Patent 1742947. Victor G. Brash.

SEW SLIDE FOR PORTABLE ELECTRIC SEWING MACHINES—An attachment which may be adjustably secured to the machine base, and will be perfectly level and flat with the sewing surface of the machine to which it may be connected. Patent 1742932. Robert W. Perry and Parker E. Abell.

TOOTHBRUSH—Having a removable head to permit of replacement, either end of the brush being secured nearest the handle, and having means for locking the head in a plurality of positions with respect to the handle. Patent 1742596. Edward R. Hoff.

VACUUM CLEANER—In which there is an intermittent suction produced by the admittance of air through a by-pass round the mouth of the nozzle, thus obviating danger of clogging, and the necessity of mechanism within the chamber itself. Patent 1742810. Richard T. Hosking.

HUMIDIFYING DEVICE—A relatively small moisture-retaining casing which may be placed within a receptacle to impart moisture to the air, and prevent the drying out of tobacco, cigars or other materials, without fear of undue moistening. Patent 1742962. Donald W. McCrosky.

Hardware and Tools

POCKETKNIFE—Wherein a proper spring action is provided for the respective blades without presenting the usual surface on the spring back, the blades co-acting with a spring means interiorly, and separate from the back. Patent 1743022. William Carman.

CUTTING TOOL—Wherein automatic power is employed for imparting the cutting impulses in the work, the tool being hand controlled, particularly adapted for cutting decayed tree trunks and forming cavities for the operations of tree surgery. Patent 1743988. George Van Yahres.

ROTARY CORE DRILL—Particularly of the type by which samples are formed, producing a core of uniform diameter, facilitating its removal from the barrel, eliminating disintegration, and insuring a core with the strata maintained in its original position. Patent 1742641. Arthur L. Armentrout.

MEASURING INSTRUMENT OR GAUGE—For engineers and mechanics, whereby shafting, piston rods and guides for locomotives, or other types of reciprocating engines may be accurately alined, the device may also be employed for determining the slope of roofing. Patent 1745252. Arthur B. Ginter.

NAIL HOLDER FOR SHINGLES—For asbestos and other artificial shingles, which will automatically move the nail to a correct position to be driven, enabling the workman to hold the shingle with one hand and hammer with the other. Patent 1745315. William J. Parker.

Heating and Lighting

OIL BURNER—Having a burner ring constructed to be raised above the fire pot thus effecting a saving of fuel also facilitating the removal for cleanings, and replacement of the ring should it become injured or require repair. Patent 1743021. William H. and Cecil E. Boston.

FORCED-DRAFT ATTACHMENT FOR FIRE BOXES—A blower and casing attachment for fire boxes of ordinary household furnaces, which causes an updraft through the fire, and directs air jets downwardly on the burning fuel, thus permitting the use of buckwheat coal. Patent 1743048. Frederick I. Sleaster.

Machines and Mechanical Devices

STONE-SAWING MACHINE—A cable saw which will cut at a comparatively increased speed, and is capable of being magnetized to pick up, and hold abrasive material such as steel shot, or metal filings, to augment the cutting. Patent 1743057. Albert E. Wienholz and Frederick Siefke.

BEATER MILL—In which a revolving beater forcibly acts upon heavier particles from a hydrating plant for lime, the heavier graded particles being automatically ejected in one direction, and the finer ejected by a separate path. Patent 1742511. William J. Kuntz.

CARD-DISPLAY MACHINE—Adapted to automatically raise the front card from a group of cards and hold the card a predetermined length of time, means being provided for two sources of lighting for illuminating non-transparent and transparent cards. Patent 1741228. William A. Garlick.

CONTENTS-DISCHARGING DEVICE FOR PUMP, DRILL, OR OTHER CYLINDERS—Susceptible of use as a general discharge support, but relating more particularly to supporting means for cylinders which may be conveniently mounted on the derrick floor, or suitable support convenient to an operator, in well drilling. Patent 1742939. Elgan S. Sloan.

VALVE MECHANISM FOR FLUSH TANKS—An automatically controlled inlet valve for controlling the flow of water to a flush tank, which is freely movable yet retained in closed position by the pressure of water in connection with a baffle. Patent 1744559. William S. Locke.

APPARATUS FOR TREATING CARBONACEOUS MATERIAL—For recovering hydrocarbon oil from oil shale, by the action of heat, for mechanically preventing the formation of clinkers in the lower combustion chamber, and at the same time reducing the spent shale to fine ash. Patent 1743394. William Rhoades.

FEELER MECHANISM—Which is not subject to wear producing lost motion and loss of adjustment, is readily adapted to standard looms, and automatically provides for a minimum of waste on filling carriers when they are ejected from the shuttle. Patent 1744630. Ernest Hall.

MACHINE FOR MAKING VERMICELLI AND SIMILAR PRODUCE—In which the nutritive qualities, aroma and flavor will be preserved in either the solid or tubular forms, and providing means whereby the matrix may be readily removed for cleaning without stopping the machine. Patent 1744591. Fernando Taurel.

DISPENSING AND VENDING MACHINE — Especially adapted for automobile fuels, whereby a single source of supply and a single discharge line may be used in connection with two measuring tanks enabling one operator to serve two customers at the same time. Patent 1744603. James W. Ames.

FLOTATION PROCESS—An ore concentrating process, employing as a reagent finely ground sawdust from pine, mixed with comminuted ore before being delivered to the flotation machine for agitation, wherein the mineral portions are caused to adhere to the wood pulp. Patent 1743463. Joseph H. Lane.

PUMP-ROD SWIVEL — To be interposed between the rigid pump rod of a deep well pump and its actuating cable, for eliminating friction due to the plunger tending to rotate in the barrel and part the rods. Patent 1745310. Theodor P. Novick.

APPARATUS FOR RECOVERING WASTE AIR FROM AN AIR-LIFT PUMP—Adapted for attachment to the discharge outlet, affording facilities for separating the air from a mixture of air and water as it passes, so that the recovered air may be available for pressure fluid. Patent 1745085. Charles E. Denton.

SHEET SEPARATOR—For copy holders, which will hold a large number of sheets, will automatically discharge the copy and display individually the line which is being copied, so that that line alone will be visible. Patent 1744337. Lewis Sharp.

PAPER-CUTTING MACHINE—Particularly constructed for sand paper, the paper being continuously fed to the knife at right angles, the cutter quickly getting out of the way after the cutting, and more slowly resuming its position for the next operation. Patent 1744818. August W. Warsen.

APPARATUS FOR IMPREGNATING STRANDED ELEMENTS—Such as rope, cords or the like, with means immersed in the impregnating substance for gripping the rope at a plurality of points to effect an opening or spreading of the strands, to permit of impregnation therebetween. Patent 1745285. Edwin J. Whiffen.

VENDING MACHINE—A sanitary coin controlled mechanism by which single cigarettes may be fed into a delivery chute in a partially projecting position so that the vendee's hands do not contact with the delivery outlet. Patent 1745254. Irving Green.

ELEVATOR - GUIDE - RAIL - LUBRICATING DEVICE—A lubricator of the capillary feed type which automatically supplies lubricant to elevator and counterweight guide rails in a uniform manner irrespective of the level of the lubricant in the reservoir. Patent 1743894. Albert Johnson.

ROAD-RESURFACING DEVICE — A machine adapted to scrape the road sufficiently to remove the high portions, and smooth or plane the road immediately following the scraping, accomplishing the work ordinarily done by two machines. Patent 1744139. William J. Patton.

DISPENSING DEVICE—For completely storing a series of bottled liquids, in the arcuately shaped path of a cooling chamber, from which the bottles may be ejected one at a time, by means of a coin-controlled rod. Patent 1743917. John E. Henderson.

MEANS FOR FACILITATING THE APPLICATION TO OR REMOVAL OF THE KNIFE FROM A PAPER CUTTING MACHINE—Which necessitates only drilling and threading of a pair of apertures, and the association therewith handle elements, whereby the knife blade may be safely handled during its application and removal. Patent 1743946. Horace S. Williams.

MACHINE FOR FACET FILING OF SAW TEETH—So arranged that it files one edge of a saw tooth without touching the adjacent tooth, and immediately afterwards the other edge of the same tooth, without the saw being moved out of its position. Patent 1743893. Carl A. Janson.

COMBINED BEATER AND VACUUM CLEANER—In the form of a cylinder having blades movable through an opening in a casing for periodically beating the carpet while the section device withdraws the dirt agitated by the beater. Patent 1743954. Benjamin F. Blake.

VENDING MACHINE—For vending single articles, such as apples, from individual compartments, a plurality of compartments being successively opened by a coin-controlled mechanism, and the empty compartments automatically replenished with an article. Patent 1743931. William A. Patton.

ROUTING AND GROOVING MACHINE—Which will, in one operation, produce grooves in wooden sticks and at the same time rout the ends of the grooves, the sticks being fed successively by mechanism which also automatically controls the operation. Patent 1744651. George R. Lessor.

Musical Devices

TRANSPOSING KEYBOARD—By means of which the instrument may be made to produce music in any key regardless of the key in which the composition is written, the keyboard itself being shifted. Patent 1743457. Henry Kinney.

PLAYER PIANO—Having mechanism for permitting musical instruments such as the piano, pipe organ, reed organ, etc., to be tuned and played in absolutely perfect intonation instead of in the tempered system now generally in use. Patent 1743458. Henry Kinney.

IMITATION KEYBOARD—Which not only simulates in appearance a piano keyboard but simulates the action, the keys having inherent resiliency so that they may be depressed and return to normal position, the pupil silently accomplishing the proper action. Patent 1745225. Osbourne McConathy.

Railways and their Accessories

RAILWAY TRACK STRUCTURE—Composed of complemented longitudinal sections assembled and joined with staggered section joints and having alining tread faces beveled inwardly in correspondence with the wheel level, thus prolonging the car wheel life, and its own life. Patent 1743598. Louis M. Coon.

Pertaining to Recreation

AQUATIC TOY—Formed from an annular buoyant element, such as the inflated inner tube of an automobile tire, with the association of a bent wire frame, affording means for supporting a seat in the water. Patent 1743333. George B. Ely.

Pertaining to Vehicles

DIRECTION INDICATOR — Especialty adapted for closed cars, whereby an arm is used for indicating stops, left-turn and right-turn, operated from the suction of the engine, and working practically in the same position as a driver signalling by hand. Patent 1741190. Anton Kessel.

TRIPLE-COMBINATION LOCK FOR STEERING GEARS, IGNITION AND TRANSMISSION OF MOTOR VEHICLES—A thief-proof combination lock, having permutation disks, and operative simultaneously on the ignition system, steering gear and transmission of an automobile, airplane or tractor, in fact any mechanism using a steering column. Patent 1742963. James F. McGlynn.

HYDRAULIC SHOCK ABSORBER—Employing a plurality of fluid resisted pistons, allowing any desired rate of shock absorption to be attained, and at the same time reduces the loss of oil or other hydraulic medium to a minimum. Patent 1743959. Arthur St.C. Dunstan.

WINDSHIELD WARMER—For preventing ice and snow from adhering to the outside, and moisture collecting on the inside, by a flow of hot air from the engine directed onto the windshield, and means for regulating the hot air. Patent 1743395. Erwin A. Rinehart.

STARTING AND LIGHT SWITCH—A simple and inexpensive switch for controlling starter motor, ignition and headlight circuits, from the instrument board of a motor vehicle, in a convenient manner, capable of installation on any of the known types of car. Patent 1743949. James G. Wortham.

ATTACHMENT FOR AUTOMOBILES AND THE LIKE—Especially adapted to be applied to the windows of an automobile for ventilating the car in cold weather without creating a draft, also having means for preventing frost or steam forming on the windows. Patent 1744154. Frank A. Bettag.

REMOVABLE BODY FOR HAND TRUCKS—Whereby the body may be loaded at a point distant and later engaged by the hand truck for transportation, the body being formed with members interlocking with the truck. Patent 1744311. Frederick L. Jacobs.

TAXI ADVERTISING DEVICE—A device which can be conveniently located inside a taxicab, bus or other vehicle for displaying advertising matter, mechanical means between the internal combustion engine and the advertising assemblage providing an automatic change. Patent 1744705. Emmanuel Dobrowsky.

AUTOMOBILE BUMPER BRACKET AND AUXILIARY SHOCK ABSORBER—Combining a bumper flexible enough to absorb up to substantially 3500 pounds, and heavy springs connecting the bumper with the chassis and designed to withstand a pressure up to substantially 15,000 pounds. Patent 1739930. Fred Ungar.

CARRIER—For more or less fragile articles comprising a skeleton cage of circular outline with expansible gripping members forming the walls of the cage, adapted for detachable clamping engagement with the running board of an automobile. Patent 1740368. Earle F. Nusser.

JACKING AND TRAVERSING ATTACHMENT FOR MOTOR VEHICLES—Whereby the front end of a vehicle may be lifted, and by means of a telescoping section and fifth wheel, swung into parking line under its own power, the attachment is adapted for vehicles of standard construction. Patent 1740385. August W. Althoff.

COLLAPSIBLE GOCART—Having the appearance and shape of an ordinary suit case when folded, the wheels and other supporting members being readily movable to a point within the body so as to be completely enclosed thereby for transportation. Patent 1742137. Daniel J. de Grasse.

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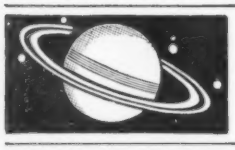

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